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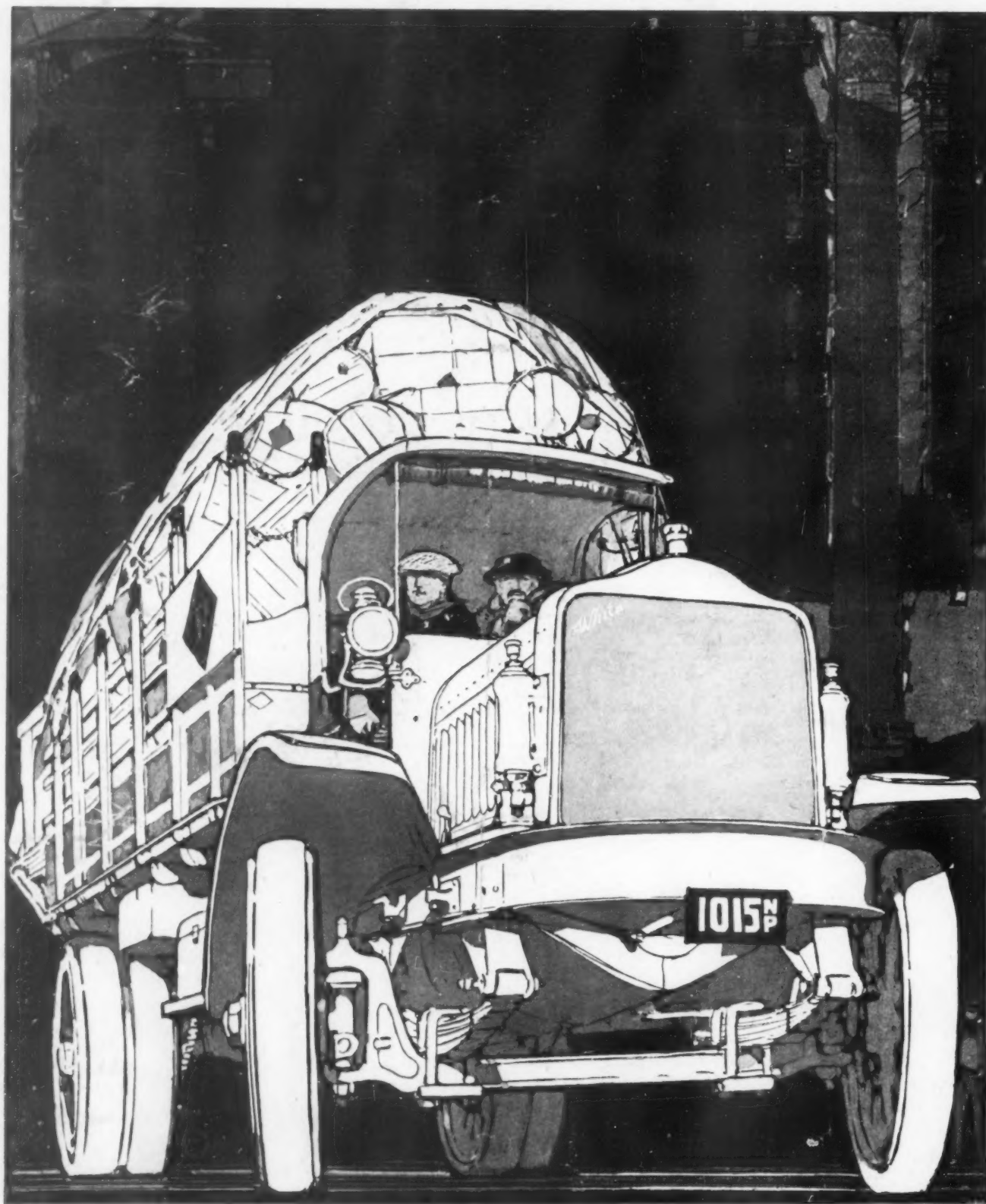
SCIENTIFIC AMERICAN



September 2, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

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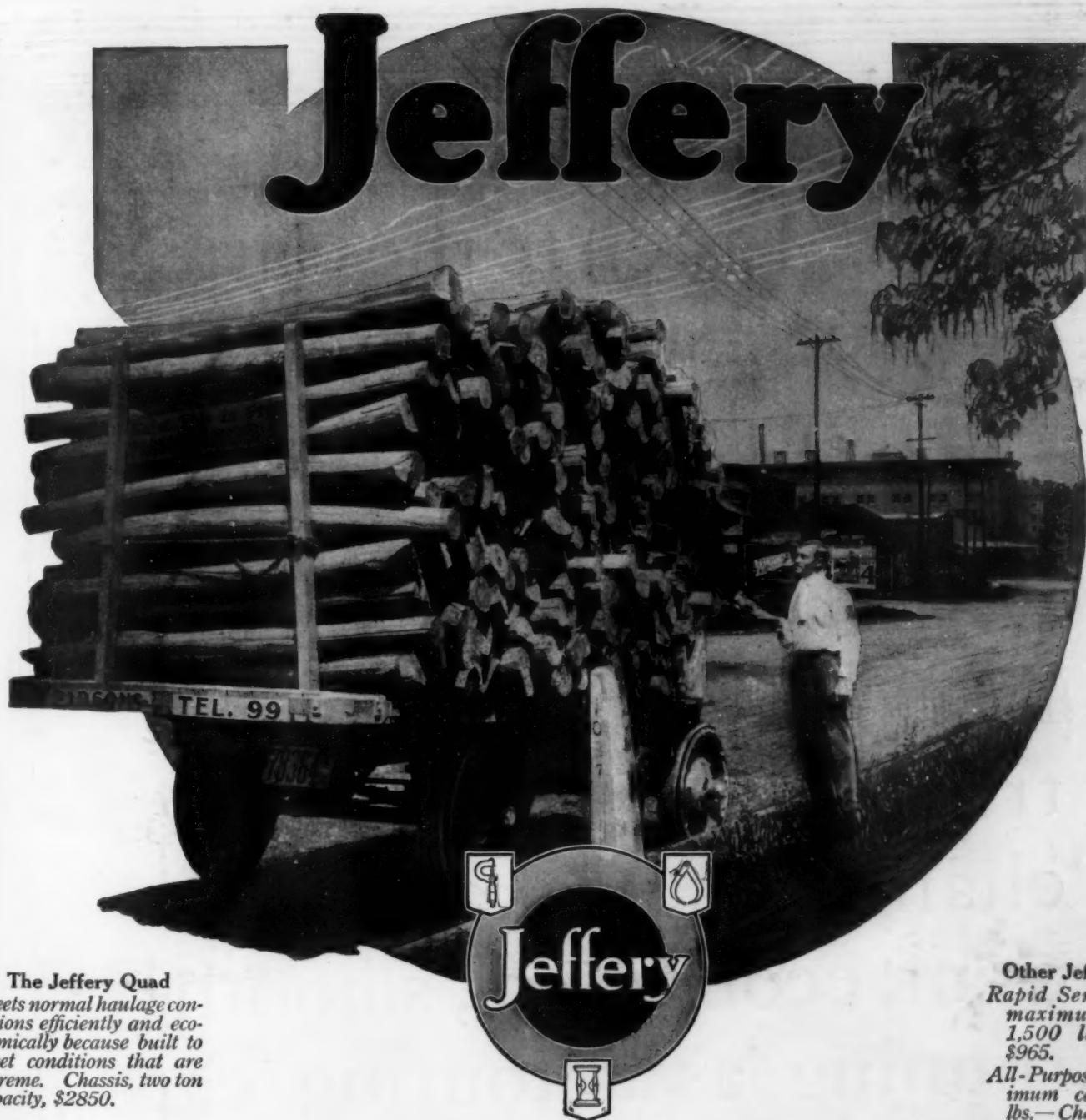
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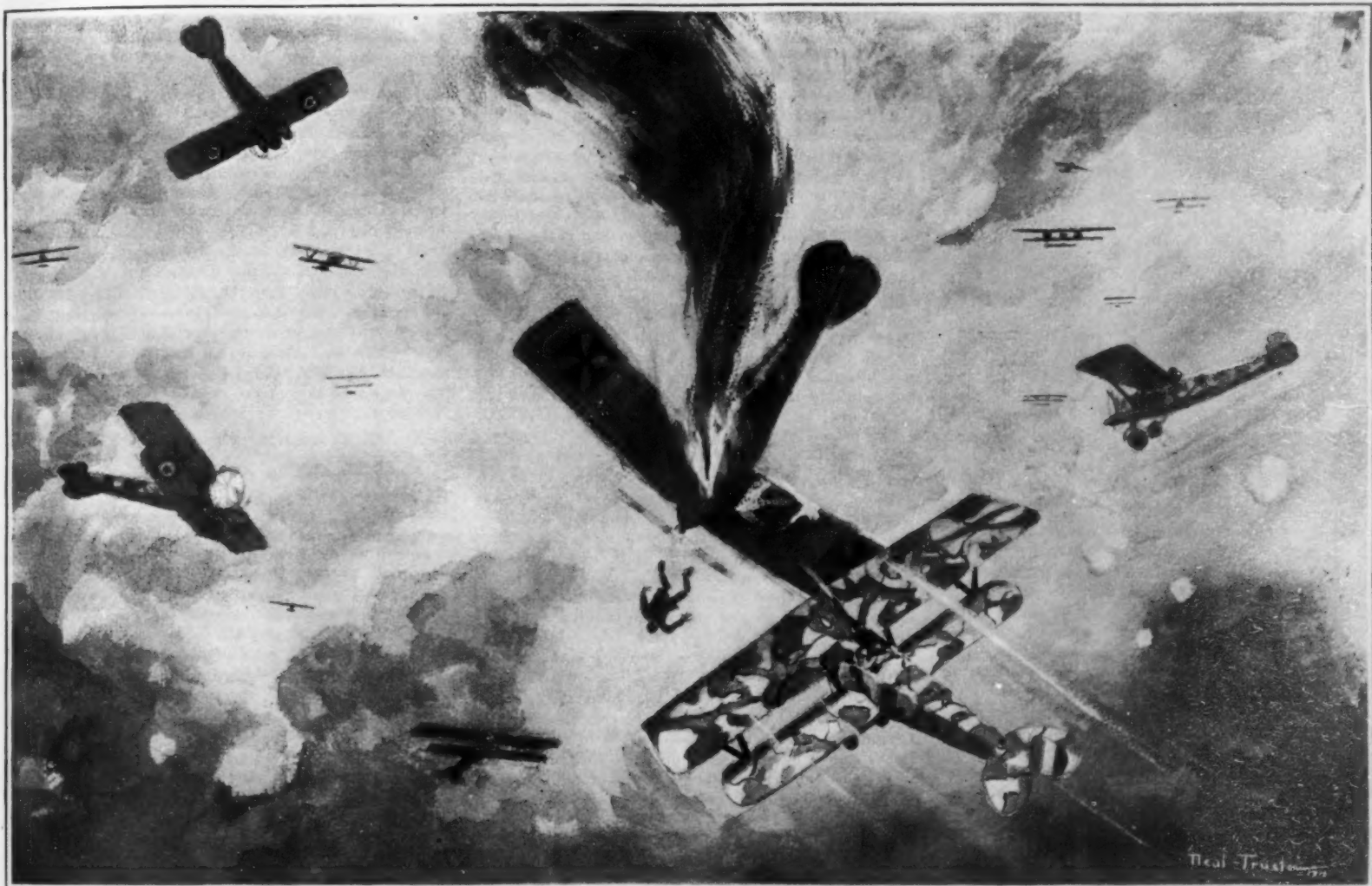
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXV.
NUMBER 10

NEW YORK, SEPTEMBER 2, 1916

15 CENTS A COPY
\$3.00 A YEAR



"Suddenly a little puff of black smoke enveloped a machine. The gasoline tank had been punctured"

Note the mottled upper surfaces of the Nieuports designed to blend with the landscape and render them invisible from above

American Aviators with the French Army

By Neal Truslow

SHELTERED by a woods some two miles back of the German trenches at Verdun, a 75 m. m. anti-aircraft gun was active. The men worked rapidly but surely. The gun was firing a shell every five seconds, and every five seconds a little puff of white smoke appeared in the sky. At first glance I wondered what the object of such activity was, but observing more closely could distinctly see a German Aviatik apparently enveloped in the smoke of the exploding shells, but in reality some distance above it.

Lieutenant Hangarier, in charge of the gun, loaned me his glasses for a moment. I then saw not one but a number of the large German planes headed toward our lines. These were convoyed by several Fokkers, which are the fastest German aeroplane used for combat and scouting purposes.

In the distance a French squadron could be seen racing to meet the invaders. The purr of their motors grew more and more distinct until they throbbed almost directly above our heads. There were ten to twelve of these French machines (Nieuport biplanes), and they were flying lower and faster than the Germans.

On they come, the sun behind them, circling, dodging, maneuvering for position and firing in the direction of the enemy. This firing while coming into range is to get the guns working freely and on the off chance of a long shot bringing down an adversary.

Lieutenant Hangarier spoke to me as the Germans flew out of range of our gun: "You see those little Nieuports up there? They are the American Squadron and a wonderful unit! All American volunteers are

under a French captain, whose first lieutenant is an American, William Thaw, of Pittsburg. They are splendid fellows, all of them, of whom we are very proud."

The combat took on a still greater interest for me and my heart leaped with enthusiasm and pride in my countrymen.

The attack had come as no great surprise. For two days the French had been bringing in great quantities of fresh troops. Heavy artillery had been brought up and the light artillery shifted. It was quite apparent that the French were planning a concentrated attack on the right bank of the Meuse. German air scouts had discovered this movement and were trying desperately to ascertain its force. Particularly were they anxious to locate the position of the artillery that they might prepare for a counter attack.

The French realized their strategic position and were equally active in preventing the German observers acquiring information. So far they had been successful. Each reconnoitering party sent out by the Germans had been repulsed and inflicted with heavy losses. Only one machine had succeeded in getting over the lines and he was driven back before he could get anything more than a general idea of the plans for the attack.

All this the lieutenant explained to me as we watched the preparations for battle going on above us. The Germans, determined to obtain the information so vital to them, had sent out a strong reconnoitering party in two sections, 15 machines in one direction and 20 in another, one purposing to draw the attention of the French while the other made the necessary observations.

The French anticipated the strategem, but not the force of the attack, and sent the American section to

meet them when word was telephoned of their approach.

The American squadron now found itself in the center of the two German sections, by whom they were being encircled. We could hear the faint rat-tat-tat of the machine guns, 12,000 feet above us, as the Americans, outnumbered three to one, replied to the German fire.

Suddenly a little puff of black smoke enveloped a machine. The gasoline tank had been punctured and caught fire. The plane darted to earth leaving a thin black streak behind it. At that great height we could not tell to which side the machine belonged. In a few moments the group around the gun began to cheer and I heard excited cries of "C'est tombe! C'est tombe! C'est un bosche!" The Americans had scored. It was a German Aviatik that had fallen.

The Germans dropped back for a moment, then the whole force came forward to attack the Americans. There was a circular counter formation on the part of the Americans and the rapid firing of the guns was accelerated. Nearly 2 miles above us the battle waged furiously. At times it was impossible to distinguish the Germans from the Americans in this most unequal fight. We saw Prince and Balsley capsize and fall. In the apparent death drop Prince righted his machine when near the ground, and returned to the Aviation Field uninjured, but with a bullet through his helmet.

Balsley was not so fortunate. He owes his life perhaps to the fact that his feet were strapped to the controls. An explosive bullet struck him in the hip, rendering him helpless for a time, but he was able to regain command of his machine sufficiently to make a

(Concluded on page 226)

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway,
New York, Saturday, September 2, 1916

Charles Allen Munn, President, Frederick C. Beach, Secretary.
Orson D. Munn, Treasurer, all at 233 Broadway

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Announcement

OWING to the marked advance in the cost of labor and materials affecting every branch of the publishing business, the price of the SCIENTIFIC AMERICAN will be raised to \$4.00 a year after October 1st, 1916.

In making this announcement we wish to explain that during the past year the price of print paper has increased from 100 to 150 per cent. There has been an advance in the cost of inks of all kinds, some of which have reached an almost prohibitive price. There has been a rise in the cost of printing and binding. Photoengraving has advanced nearly 100 per cent, and electrotyping metal now costs more than ever before.

The factors which have contributed to the present situation are only in part attributable to the war. Prices now prevailing are certain to continue with, at best, but a slight diminution, even after the struggle in Europe comes to an end.

While enduring these additional and unprecedented expenses, we have not permitted the SCIENTIFIC AMERICAN to suffer. In fact, we have improved it in form and size. In addition to the colored covers, which we are now publishing weekly, we beg to call attention to the fact that in 1915 the number of pages of the SCIENTIFIC AMERICAN amounted to 1210 as against 981 pages in 1909. This year we are publishing still larger editions, and it is probable that the total number of pages for 1916 will be close to 1300.

We have spared no expense to improve the editorial quality of the SCIENTIFIC AMERICAN. During the past year we have published many special articles on the war, and particularly on industrial conditions as now affected by the war and as they probably will exist when the European nations lay down their arms and return to their productive work.

Because the SCIENTIFIC AMERICAN is costing much more to produce than it ever did before, and because we are giving our subscribers a better product than ever before in the history of the journal, we are compelled to make the change in the price of subscription.

The Need of the United States for Naval Scouts and an Auxiliary Coast-Patrol

THE memory of the people of the United States is short. The lessons of one war are soon forgotten. In 1898, in the Spanish-American War, the entire Atlantic seaboard was in a state bordering on hysteria over the approach of the Spanish squadron,—and the menacing force was not very strong and was unaccompanied by any invading force; the fear of our people was due, in large part, to the uncertainty as to the point at which this force would strike. This fear would be infinitely greater were the enemy-force made up of powerful vessels of war, with a convoy of troop-ships filled with veteran soldiers. Yet, eighteen years afterwards, this country has no adequate or effective means of ascertaining at what point of our long coast-line a hostile force would strike. We have but three scouting-vessels in the Navy,—and no merchant marine from which to draw suitable vessels for scouting. We had five of such vessels in the Spanish-American War,—and these failed to find Admiral Cervera's squadron. While this failure was due in part to the circumstance that the five scouts were not employed in the right way, yet subsequent study has shown that with an adequate number of scouts, and with more attention before the war to problems of scouting, Cervera's squadron could have been located, probably destroyed, and the whole costly campaign around Santiago, both afloat and ashore, could have been avoided. All this has been forgotten,—at least by those who have passed through the halls of Congress. The sea is wide. Most people believe, as has been said: "The best friends of Uncle Sam are the Atlantic and Pacific Oceans."

But those who hold so firmly and fondly to this belief ignore the progress that has been made in the building of ships, the great increase in the mobility of naval forces, the vast extent and trackless nature of the ocean. The sea has changed from a barrier to the most convenient way of passage. As far as war-like operations are concerned, the sea differs essentially from the land. Admiral Mahan thus pointed out this difference: "Armies pass through countries more or less inhabited by a stationary population, and they leave behind them traces of their march. Fleets move through a desert over which wanderers flit, but where they do not remain; and, as the waters close behind them, an occasional wail from the decks may indicate their passage, but tells nothing of their course. The sail spoken by the pursuer may know nothing of the pursued, which yet passed the point of parley but a few days or hours before." A naval force at sea may take any one of a large number of routes. The Germans, to attack France, were forced to go through Belgium. Under modern conditions an enemy ashore can be found; at sea he cannot, as a rule,—and then usually only after considerable time and search.

The "sea-frontier" (as it has been aptly termed by Lieut. Commander Cotten) of the United States is of very great length; this sea-frontier may be roughly outlined by drawing a line 150 to 200 miles distant from and generally parallel to the coast-line of the United States from the easternmost point of Maine to the southernmost point of Florida, then out and around Porto Rico, back around Jamaica, and then south to Panama,—for the Atlantic side. Similarly, on the Pacific side, the line begins at Alaska, carries around the Aleutian Islands, south to Midway Island, by Guam to and around the Philippines, then eastward around Samoa and back to Panama. In the event of war in either ocean, the enemy may cross this line at any point; he may strike immediately at Boston or one of the other large coast-cities; he may attempt to seize a base of operations in the West Indies; he may decide to seize or to block the Panama Canal. Our first concern would be to determine where he would cross this long sea-frontier. We are practically without means of determining this. The best we could do would be to hold our fleet concentrated in some strategically central position, ready to go north, south, east or west as the determined movements of the enemy might dictate; and until we gained information of the enemy's movements, the Admiral and the whole country would remain in awful and heartbreaking uncertainty. This is not the phantom fear of an alarmist brain; it is a pitiful fact. A perusal of the newspapers of June, 1898, will show the painful effect of such uncertainty.

How can we remedy such a sorry condition as this? Despite the repeated recommendations of the General Board over a period of several years, we yet have but three scouts; and these three are not of the best type. Of battle-cruisers,—a type of vessel particularly useful in picking up and holding on to any enemy's force, we have none; for, although a scout may find an enemy's force, the scout may be driven off and lose touch; and a scout cannot break through the protecting screen with which the convoy will be surrounded, and therefore cannot ascertain the nature and size of either the convoy or the main force which accompanies the convoy. All this a battle-cruiser can do. In our existing state, we should be forced to use our torpedo-vessels for scouting; and they are neither intended nor fitted for such work; their fuel endurance is insufficient, and they cannot work under adverse weather conditions. Should war come on us to-morrow, the hysteria of 1898 would be seen again,—in ten-fold more exaggerated form. But,—the sea is wide, no nation bears us any ill-will, war is a remote possibility, we covet the possessions of no other nation, etc. But again, if war should come, we should have to do something at once to supply our scouting deficiencies. The chances are that we should have to abandon all idea of intercepting the enemy at any distance from our coasts and try to devise means of finding him before he actually effected a landing. The cheapest and quickest means of providing a force wherewith to do this would be to establish a large number of coast-stations (100 miles apart, say), each equipped with at least six aeroplanes and with communication by wireless; also, to equip as many vessels as possible with aeroplanes and launching devices,—to cover as long an extent of our sea-frontier as possible. The shore-planes, starting out from their respective stations one at a time and at intervals, could fly around a triangular course, 100 miles out, 100 miles up or down, 100 miles back; the planes on board the special ships could operate similarly. Even then, with all the ships and planes we could muster, there would be uncovered gaps. The services of every seagoing motor boat and of all the 1,100 alongshore craft on the Atlantic Coast would be needed,—as well as the services of every aircraft and of every aviator that could be mustered; and even then there would be a good chance that the enemy might evade us.

It is such considerations as these that make of great importance the enlisting by the Government of the co-operation of owners of motor-boats and flying-boats,—the first step towards which will be taken by the participation, this month, of motor-boats in the exercises in the last week of the training cruise for civilians. There are many such vessels which would be of the greatest service in time of war,—in offshore patrol work, for harbor patrol, for laying mines, for sweeping for and picking up mines, for guarding mine-fields, for carrying dispatches, etc.; the intimate knowledge of local conditions and of the local coast possessed by the owners of these vessels would be of the greatest value; many of these boats would make valuable chasers for submarines. The uses to which they might be put are manifold. It is believed that this training cruise will serve to stimulate interest in the Navy and in its needs, and will lead to a well-worked-out plan for the co-operation and co-ordination of the many valuable naval auxiliaries which have been heretofore ignored.

What does Alcohol do to Chickens?

IN the Proceedings of the American Philosophical Society Dr. Raymond Pearl gives an account of a series of experiments on alcohol feeding which he has been conducting on chickens. The work was started with the expectation that offspring of alcoholic chickens would be obtained which differed in one or more particulars from the parent and that these new types of birds could be used in various breeding experiments towards solving the highly complex problems relating to heredity. The results obtained were a surprise.

The birds used in the experiment received their dosage of alcohol by inhalation one hour every day for several months. After a year and a half of such debauchery they differed from their sisters and brothers, who were kept as controls, in that they were somewhat heavier in weight and were less active. Otherwise there was no visible change. The death rate among the alcoholic birds was very low as compared with the non-alcoholics; but in view of the small numbers of chickens used in the experiment (there were nineteen birds specially treated), Dr. Pearl considers it impossible to say that alcohol had anything to do with this.

The birds receiving the alcohol were first bred in the spring of 1915. Contrary to expectation their offspring were perfectly normal. Not one of the chicks showed any deviation from the ordinary type. But several interesting facts shown by a statistical study of the data collected emphasized the need for extensive and critical work on the treatment of animals with alcohol and its effect on the offspring, and also suggest that possibly there is much to do in a scientific way on the effect of alcohol upon the human race.

In order to obtain as complete a knowledge as possible concerning what kind of progeny the alcoholized chickens produced an elaborate series of data was collected not only on the growing chicks, but also upon the eggs during the period of incubation. It was found that the birds receiving alcohol produced a larger number of infertile eggs than did those which were deprived of this luxury.

On the other hand in hatching quality the eggs of the alcoholic birds were superior. As regards the condition of the chicks after they had pecked their way into the world, those of alcoholic parentage seem to have the advantage over those whose parents received plain chicken fare. Although all the young chicks received precisely the same treatment as regards food and housing conditions, and thus had equal chances for life and development, a larger percentage of the offspring of alcoholic birds reached maturity than did those of the untreated birds. Furthermore, although while the chickens were very young there was no difference in the body weight between the two sets of birds, after three or four months the progeny of the alcoholic birds began to gain in weight faster than the control chicks.

In explanation of the results obtained Dr. Pearl suggests that "alcohol acts as a selective agent upon the germ cells of alcoholized animals." It is a recognized fact that there is a considerable variation in the vigor of the germinal cells of any one animal. The hypothesis is advanced that the effect of the alcohol on the germ plasm of the chickens was to render inactive the weaker germ cells. Those germ cells which were vigorous and had high resisting powers withstood the effect of the alcohol. The result was that the germinal cells destined to produce weak individuals were eliminated. The progeny of the alcoholic parents, with only the strongest individuals developing, thus made a better showing than did the offspring of the non-alcoholic birds where the weak germ cells as well as the strong developed. Dr. Pearl further suggests that in those experiments where defective and abnormal types are obtained from alcoholized parents, such as Dr. Stockard has reported from his work with guinea pigs, these defectives were from normal germ cells which had a low resisting power.

Electricity

Increased Popularity of Electric Cooking among Birds is reported by the *Edison Current Topics*, published by the Southern California Edison Company. It is reported that recently two transmission line short circuits were caused by birds dropping small snakes across the bared cables. In each instance the snakes were beautifully toasted!

A Convenient Flashing Plug.—An American manufacturer has recently introduced an automatic flashing plug which can be used without adjustment with tungsten lamps ranging in rating from 20 to 60 watts, and for voltages of 50 to 220. It is further stated that the device is not affected by changes in temperature, and it can be adjusted without removal from receptacle.

Improved X-Ray Tube.—In patent No. 1,192,706, recently granted to Prof. Elihu Thompson, there is disclosed a novel method of avoiding the overheating and melting of the electrode in an X-ray tube by the cathode ray bombardment. The target or electrode of the cathode rays is made in the form of a wheel, which is so mounted that the rays impinge on it tangentially, causing it to revolve and thus offer successively a new surface to the operation of the tube.

Electrolytic Production of Zinc.—At Drammen, Norway, new zinc works are about to be started for the extraction of zinc by an electric wet process invented by a Belgian engineer, M. Strubelle, states *The Electrician*. Raw materials for the first year, about 10,000 tons, have been secured, and special attention will be paid to ores containing from 8 to 30 per cent zinc, which have hitherto been considered as really worthless.

A "Daylight" Lamp.—A New York concern is marketing a new type of nitrogen-filled blue-glass lamp that gives a white light of daylight quality. The daylight color of the lamp is due to the special glass used. However, contrary to expectations, the color of the glass only results in cutting down the volume of light 8 per cent. At present the lamps are available in all sizes from 100 up to 1,000 watts. The current consumption is about $\frac{1}{2}$ watt per candle-power.

Electric Arc Welding.—Machine shops are materially adding to their profits by using electric arc welding in their work. For electric arc welding eliminates the losses of the scrap heap. Metal can be added to faulty castings, blowholes filled in, lugs and parts added and low spots built up. Further, there is perhaps no better, quicker, or cheaper method of making up, assembling and repairing articles of iron and steel castings or forgings, piping, etc.

Copper Oxide Electrically Sensitive to Light.—At the June meeting of the New York Electrical Society a paper was read by Theodore W. Case, describing experiments on the action of light on oxidized copper. If two copper wires or plates are oxidized and immersed in an electrolyte, a galvanometer connected between them will be deflected when light falls upon one wire or plate. The voltage observed was about 0.1 volt. The current obtainable depends upon the area of the plates and approximated 0.2 ampere. Many variations of the experiment were described in the paper.

The Australian Metal Industry.—Provided certain trials now being carried out in the United States are satisfactory, a large zinc concern will shortly establish in Tasmania big works for the electrolytic treatment of zinc concentrates and the production of zinc. The first unit will take at least 10,000 electrical horse-power and the directors estimate that if they get in practice the results they are figuring upon, the extensions of plant and the establishment of allied industries to work up the raw material will require between 40,000 and 50,000 horse-power. The power is to be supplied by the State Government's hydroelectric system at about \$10 per horse-power per annum, with a possible reduction for over 10,000 horse-power.

A Novel Commutator.—Something new in small commutators has recently been introduced. Its construction, in brief, is as follows: Segments are assembled with mica separators as usual, and bakelite is then molded about the commutator's free surface to hold the segments together. The operation of molding this substance is performed with a die in a hydraulic press. Pressure is first applied at 2,000 pounds per square inch. Heat is then applied, and as the temperature of the die is raised to 400 deg. F., the pressure is increased to 6,000 pounds per square inch. This method of construction is said to eliminate entirely the possibility of grounds or short circuits, since no metal other than copper segments is used. During experiments conducted by the writer of this note, these commutators showed no signs of fracture when heated to 500 deg. F., while subjected to a peripheral speed test of 8,000 feet per minute.

Science

Meteors Revolving Around the Earth.—A remarkable swarm of meteors passed across Canada on February 9, 1913, having been first seen over Saskatchewan, whence they traveled in a direction south of east, and were seen by several observers in Bermuda. These meteors were reported by hundreds of people in Canada, and some detailed discussions of them have been published. Their altitude above the earth when traveling over Canada has been computed at about 42 miles. Mr. Denning, the English authority on meteors, has collected further observations from seafaring men through the medium of the *Nautical Magazine*, and has thus been able to extend the known path of the meteors to about 5,500 miles. So long a trajectory is unprecedented in the history of astronomy. The most interesting fact in connection with these meteors, however, is that, since they were at no time more than about 100 miles above the earth, they must have followed the curvature of the latter; in other words, they were revolving around the earth after the manner of satellites. Now comes the suggestion from Mr. Gavin J. Burns that they may have passed several times around the earth, before the resistance of the atmosphere diminished their speed to such a degree that they fell to the ground, unless previously dissipated. He supposes that when "captured" they must have been traveling in an orbit very similar to that of the earth, and hence had a very small velocity relative to the earth.

Bob Veal.—The belief that immature veal—i. e., the meat of calves less than about three weeks old—is unfit for human food is quite generally held both in this country and abroad, and the sale of such meat has even been prohibited by law. Apparently this is one of the many cases in which an idea has gained currency, not only with the public at large, but also among scientific men, by dint of reiteration rather than observation. A few years ago Dr. P. A. Fish reported the results of dietetic experiments in which seven families of 20 persons of various ages were given immature veal as part of their diet, and suffered no disturbance of any of the bodily functions therefrom. More recently the same investigator has found that beef and immature veal digest with equal speed in pepsin-hydrochloric acid. In 1914, J. C. Sparapani studied the alleged toxicity of fetal flesh, and found that bovine fetal serum was actually less toxic than adult serum. Finally, in the *Journal of Agricultural Research*, W. N. Berg, after reviewing the whole subject, gives the results of his own experiments with the flesh of some 40 calves, each seven days old or less. Chemical analyses showed no differences, of physiological significance, between such flesh and mature beef, while in a large number of artificial digestion experiments the former digested as fast as the latter. Cats fed on a diet in which immature veal was the sole source of nitrogen grew normally, the older animals becoming fat and breeding healthy kittens. Apparently "bob" veal has been maligned.

Comfort at High Altitudes.—The Mount Rose Observatory, University of Nevada, offers the following two suggestions, which are particularly valuable where food must be cached for long intervals of time and where parties are exposed to the intense light that prevails on snow-fields.

Steaks when frozen solid can be restored to their original juiciness by the simple expedient of thawing them out in cold water. The process can be accelerated by working the meat with the fingers. By using this method the dryness that usually prevails in frozen steaks can be entirely avoided.

The usual burning of lips and faces while crossing snow-fields can be completely prevented by wearing a face mask made of the lower half of a cloth flour sack. An oval slit should be made opposite the eyes for breathing and seeing. The sack can be worn over the hat or under it as desired. If the air is calm, the sack should hang loosely about the neck to permit ventilation. If the wind is blowing, the edges of the sack can be tucked within the coat collar, for sufficient air will be forced through the coarse fabric. The upper half of the sack also can be utilized as a mask by closing one of the open ends with safety pins.

This face mask can be adjusted to any face by drawing it to the proper position and holding it in place by means of the hat. With this protection parties engaged in snow-surveying have spent from one to two weeks on snow-fields without discomfort. Other preventives and remedies that usually failed have now been discarded. The flour sack adds no appreciable extra weight to the pack and is available at a moment's notice.

The flour sack mask is also sufficiently warm to afford protection for face and ears against the cold winds that blow occasionally in spring and summer.

Though such a mask affords partial protection for the eyes against snow glare, it should not be used as a substitute for amber or other colored goggles.

Automobile

Motor Fuels in Germany After the War.—Even before the war considerable attention had been given to substitutes for gasoline, but the scarcity of this fuel of late has compelled the use of other fluids, with the result that at present benzene and alcohol are very generally used, motors having been altered so that they use one, or both, of these fuels successfully. The results have been so satisfactory that it is predicted that after the war the use of these fuels will be very generally continued, especially in commercial vehicles.

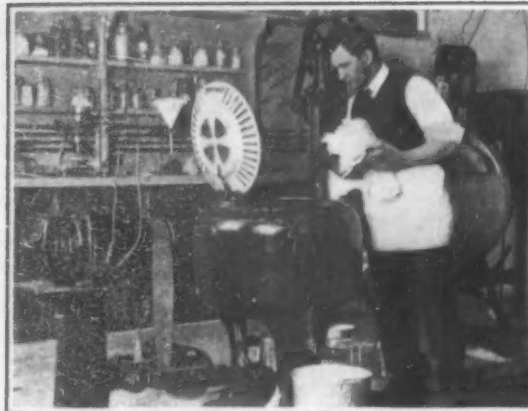
Growth of the Automobile Industry.—According to a report of the U. S. Department of Agriculture there were 2,245,664 motor cars in the United States on December 31, 1915, as against 48,600 in 1906. While these figures may be somewhat exaggerated, when compared with a compilation of license statistics of the various states, they are near enough to give a vivid idea of the growth of the motor industry. The total gross motor-vehicle registration and license revenues are given as \$18,245,713, of which practically 90 per cent is available for road improvement, so that it will be appreciated what a benefit to the entire country the automobile has been, and is.

An Auxiliary Air Device.—A device which, in view of the low grade motor fuel now on the market, appears to have some merit has recently been developed. In the lower end of the overflow pipe from the radiator of an automobile is placed a trap valve that will allow any condensation, or overflow water, to escape, but retains the steam or watery vapors. From a point above the trap valve a pipe leads to the inlet manifold, where it connects with a small spring-controlled mushroom valve opening into the manifold. In its course this connecting pipe is led along in contact with the exhaust manifold, in order to keep hot, and prevent condensation of the watery vapor passing through it. It will be appreciated that this device operates in the same way as a number of other auxiliary attachments, but it admits hot, moist air to the manifold instead of the ordinary atmosphere. It is claimed that this results in a very satisfactory increase in economy, together with increased power.

Pistons Binding.—Complaints are not infrequent by owners of cars of the pistons binding, with an accompanying sluggish action of the engine and overheating of cylinders. Usually this is attributed to a tight-fitting piston, or to improperly fitted rings; but it is probable that in many cases this trouble is due to the warping of the cylinder when heated. The valve pockets, jackets and lugs, that are cast integral with the cylinder, make an unsymmetrical distribution of the metal, and consequently, when expansion takes place, it is unequal in the different parts of the cylinder, which is swelled out of shape. One advantage of overhead valve engines is the getting rid of the side valve pockets, and securing symmetrical distributions of the metal.

A method that was adopted by a German builder for overcoming the difficulty was to lap the cylinder, running the lapping machine at such a high speed that the cylinder was heated nearly red hot in the process. This insured that the lapping was performed at a temperature fully as high as it would be when heated by the exploding gases, and consequently was brought to finished form when hot. It is said that the plan was quite successful.

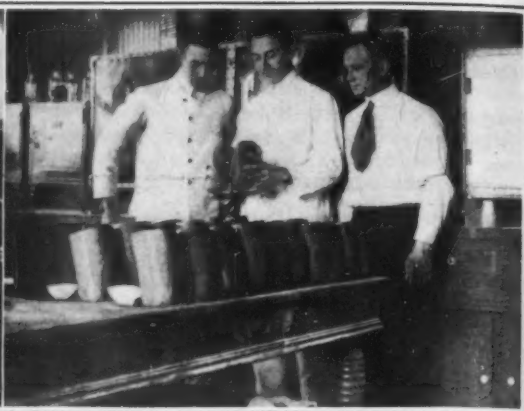
Motor Fuels.—Among the cheaper motor fuels that have been used abroad with considerable satisfaction is benzol, a coal tar distillation product, which, before the war, could be bought at a lower price than gasoline. In this country benzol has never been produced in very considerable quantities as there was no great demand for it by dye manufacturers, who are the principal consumers. It is to be hoped that the dye manufacture will be so firmly established in this country, and on a sufficiently large scale, to induce gas and coke producers to recover the benzol resulting from their processes, which has been largely wasted heretofore, when there may be a surplus sufficient to materially increase our supplies of motor fuels; for benzol can be used with most carbureters with little or no change, by proper adjustment. Another fuel of which we hear very little is a mixture of kerosene and gasoline. Of course the producers of gasoline have gone as far as they dare in such combinations, at the price they exact, but something more can be done by the user in this direction to reduce his expenses. Little has been heard of this matter in the automobile field, but motorcyclists abroad have made rather extensive experiments, with the result that they find a half and half mixture can be successfully used with their ordinary carburetor, no difficulty being experienced in starting with this mixture. Special adjustment of the air is necessary, and in some carbureters it might be desirable to also fit a smaller jet; but no material change is necessary in the average carburetor. A greater percentage of kerosene appears to be of no material advantage, and starting becomes difficult.



A scientific investigation of the laundry bill



Increasing glass production twenty per cent



Better bread for less money

Blazing a Trail for the Industries

Contributions of the Mellon Institute of Pittsburgh, Toward Scientific Investigation of Industrial Problems

By Harry Knowles

THE alliance between science and industry is less than ten years old in America, though the two were united successfully before that by the Germans. In this country the plan was inaugurated by Dr. Robert Kennedy Duncan, at the time Professor of Industrial Chemistry at the University of Kansas. He proposed that industrialists compensate skilled chemists while the latter were conducting investigations, under the supervision of a university, for improving the methods of manufacture, and that the investigator further receive a bonus whenever his solution was put into successful operation at the manufacturer's plant.

The idea spread and in 1911 Dr. Duncan was invited to establish his system at the University of Pittsburgh. Though opened with limited resources, the scheme made good from the start, both with the university and with the manufacturers of the "industrial workshop of the world." Two years later the alliance between industry and learning was permanently established by a gift of over half a million dollars from Andrew W. and Richard B. Mellon, two Pittsburghers who had been favorably impressed with the practical results already achieved. Of this sum, half was expended for the erection of a building named, in honor of the donors, the Mellon Institute, while the balance went into an endowment fund. This fund pays all the expenses of the institute save the salaries of the investigators, so that every cent laid out by the manufacturer patrons goes for that one purpose alone.

From start to finish the investigations at the Mellon Institute are preeminently practical. Before being assigned a laboratory in which to conduct his researches, every chemist must visit his manufacturer's plant for a sufficient length of time to familiarize himself with all the important details of the processes of manufacture. He thus becomes thoroughly conversant with the application of science to that particular industry, learns wherein it may benefit, and comes in intimate contact with those who are to make use of his discoveries. Having acquainted himself with the precise nature of the problem assigned him for solution, he enters an institute laboratory to pursue whatever lines of investigation he deems advisable. Thereafter the measure of success depends altogether upon his initiative, knowledge and creative ability.

Conditions at the Mellon Institute are ideal for this kind of work. Here a chemist never is handicapped by inadequate equipment, nor hampered by driving executives with demands of results in an unreasonably short time. Instead, provided with equipment and supplies that can be duplicated nowhere else, he labors in an atmosphere conducive to professional research. For weeks, months, sometimes years, he works on, unhampered, unfettered, till the day arrives when he announces to the company that pays his salary, and to the world in general, that he has found what he sought.

Now comes the application of his knowledge to the requirements of the industry in question. But not immediately is his solution adopted at the factory. First the scientist tries it out in a "unit plant," where manufacturing conditions are duplicated on a small scale. Here laboratory idealism is replaced by industrial processes. The results must be exactly what are to be expected in actual manufacture, or the investigation is considered impractical. Finally comes the test at the factory. The investigator supervises the application of his methods to actual manufacturing on a commercial scale. When it has been demonstrated beyond possible doubt that the experiment will save money in producing a superior product at a lower cost, the transaction is considered as finished.

The industrial fellowships are of two kinds, individual and multiple, the latter being for several men engaged on the same problem under the direction of a senior fellow. All investigators are responsible to the head of the institute. Each fellow is subject to a definite agreement, providing that the manufacturer shall pay a certain sum of money monthly, as compensation for his entire time, to the scientist nominated by the director. All discoveries made by the fellow during the period of his fellowship are the property of the concern paying his salary. Even patents, though taken out in the name of the investigator, are assigned to the manufacturer. The fellow is privileged to publish any results of his investigations that are not injurious to his donor, who, however, may delay publication for a period of three years. After this, the discoveries must be made public. In addition to salary, many fellowships provide for pay-

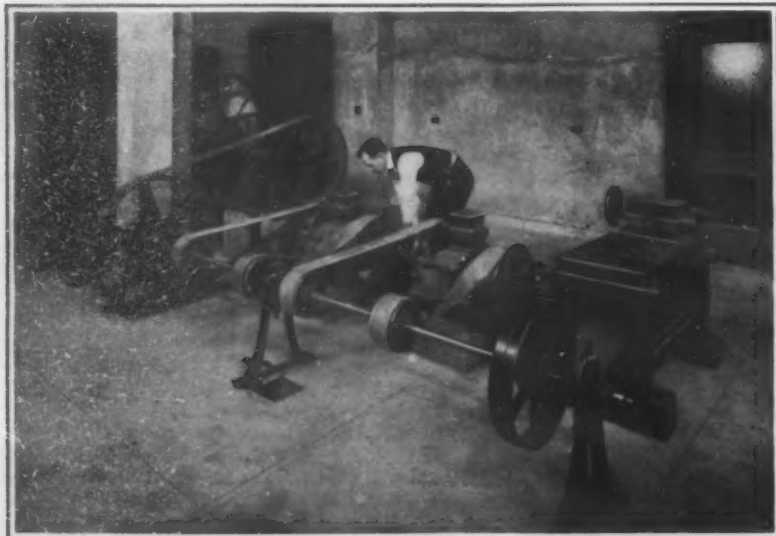
ment of a bonus whenever the results are of commercial value.

Industrialists are naturally jealous of their trade secrets; whatever they impart to the chemists must never be disclosed, lest irreparable injury result. So it is a rigid rule at the institute that no fellow shall ever inquire what his associates are doing, though they may weigh chemicals on the same balances, work at the same table, and even take advantage of one another's specialized knowledge by consultation about perplexing matters. Since the institute has been in operation there has never been occasion to question the adherence of any member to this standard of honor.

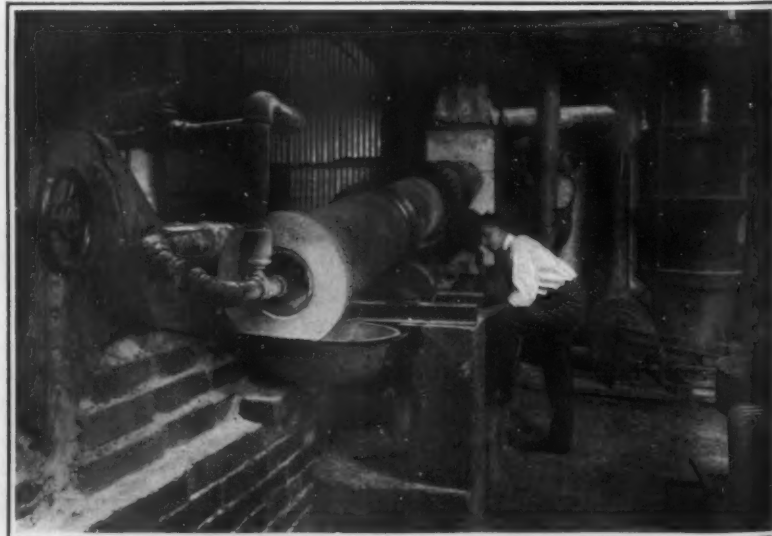
It is surprising, perhaps, to learn that the supply of men capable of working at high efficiency as investigators is well below the demand. Among the qualifications stressed as essential for these workers are "active optimism," "creative power" embodying inspiration, ingenuity and insight, sound judgment coupled with courage of convictions, and of course experimental accuracy. That this is a rare combination is apparent; that there should be a considerable number of manufacturers ready to buy it blindly might indicate that corporate intelligence is slandered in the popular estimation.

Designed specifically for an industrial problem workshop, the Mellon Institute building meets every requirement. Each of the eighteen individual laboratories measures ten and one half by twenty and one half feet, while those intended for multiple research are about twice this size. In the laboratory for special work, containing the instruments of precision, is a raised platform supported on reinforced concrete columns that go down to separate rock footings. Thus this table comes in contact with no part of the building construction, and all possibility of jars is eliminated. Two expert machinists are kept busy in the machine shop supplying the special instruments required by investigators, few of which are purchasable complete. This alone is a tremendous economy and advantage. The ordinary chemist has frequently to interrupt his investigations while he makes, or secures from a long distance, certain apparatus. Nothing like this can happen at the Mellon.

(Concluded on page 223)



A study of machinery for grinding, pulverizing and pressing



Interior of a "unit plant" where actual manufacturing conditions are reproduced

New Types of Artificial Arms for Victims of the War

Ingenious Devices Which Enable the Maimed to Resume Their Places in the Industries

By Jacques Boyer

THE artificial arms now being produced for the benefit of those mutilated in the war are no longer merely designed to mask the loss of a member. They are ingenious mechanisms, based on sound physiological considerations, devised with cunning and put together with art. With their aid these "glorious cripples," as the French call them, are able either to resume their previous occupations, or to exercise a new profession demanding somewhat less manual dexterity, or at least, in the most desperate cases, to execute without distress the movements essential for daily existence.

For those *amputés* who have preserved the elbow joint, an American firm constructs an artificial arm with which are possible a large variety of movements. Flexions of the wrist, opening and rotation of the "hand," placing the "fingers" in certain positions and holding them firmly there, are all accomplished with no intervention of the other hand aside from the engaging and disengaging of a catch. A German firm has perfected a system attached rigidly to the shoulder whereby movements based upon the humerus, collar-bone, or shoulder-blade are transmitted to the stump of the fore-arm. The hook terminating this artificial arm can be subjected to heavy loads without in the least straining the enfeebled muscles of the wounded man.

More recently, organized effort has been made by the French authorities to place the entire technique of artificial limb supply upon a standardized scientific basis. At the laboratory of military prosthesis established in Paris careful determinations are made of the muscular and nervous conditions in and around the damaged limb. In accordance with these observations individual prescriptions are made and carried out with a degree of skill which could not by any possibility be approached in times of peace, with the negligible number of cases which then arises.

The ordinary type of arm supplied to laborers and mechanics consists of a thin steel bar terminating in a sort of crab-foot attachment. The base of this is a steel cup with leather backing. The latter is either hard and molded to the stump-end, or soft and laced about it, according to the length and shape of the stump. The steel and leather cup is firmly strapped to the shoulder in such a way as to be governed by a band passing about the chest and under the opposite arm-pit. There is at the point where the steel bar enters this cup a most ingenious joint combining the ball and socket and the screw principles, while in addition the bar carries an ordinary hinge joint. Both these joints are supplied with stops which can be set either to hold them rigid in any desired position or to leave them free to operate, checking them at a given point. These must be set by the other (natural) hand. There is no independent motion of the crab-foot hand; it is merely set by the natural hand to grip the tool, which is released in the same way when the operation is completed. The motive power is of course supplied by the muscles of the upper arm, the shoulder and the chest; or in extreme cases by swaying of the body. It is most extraordinary how skillful the *amputés* become in the manipulation of this arm. It is interesting to note, also, that when he has finished his day's task, the workman unscrews his working hand and replaces it with a more elegant "hand of parade" for public exhibition on the streets.

For the clerical or professional worker and the skilled artisan there is made a much more elaborate hand. It is of nicked copper, with separate fingers, and even simulated finger nails. The metal shell of the palm is made in two pieces, front and back, leaving, when fitted together, holes from which project the fingers. Each of these is in one piece and therefore rigid, but gracefully curved. Each is hinged onto a

common axis inside the shell of the palm, and held in closed position by a spring. Levers of steel passing over a cog-wheel control these hinges, and at this cog-wheel terminates a flexible steel cable passing in a leather tube under the arms and about the chest. These features are all shown in the excellent cut below in the center.

The motive power for the operations of this hand is furnished by expansions and contractions of the chest, which affect the flexible cable. The mechanical arrangements of the hand are such that the fingers imitate in their workings the motions of those of a natural hand; the proprietor does not have to concern himself with the details at all. He merely generates the power and the machinery does the rest. He is able to grasp all manner of objects, either in the hand or between two fingers; even the handling of a match or a pin is not at all beyond him.

We present several photographs showing these hands in use, which are by all odds the most striking of their sort that we have seen.

Steam-Driven Seaplanes

NAVY Department experiments indicate that steam driven seaplanes may solve the motor problem of air navigation. Many officers believe that only the question of getting the weight of the steam plant down to the lowest possible figure remains to be answered before a steamer of the air is constructed and tried out.

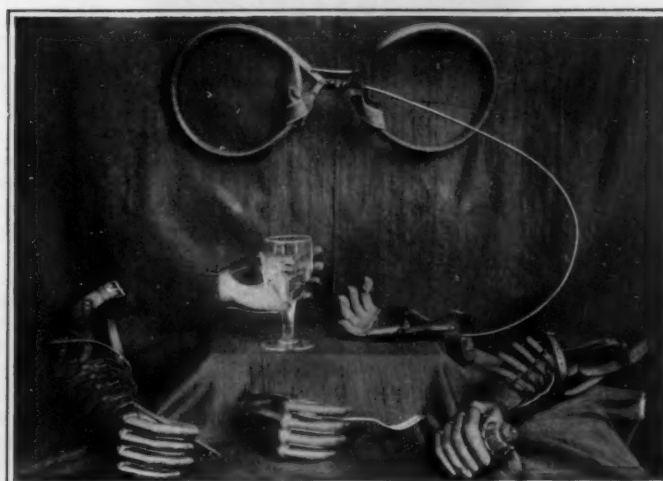
Steam equipment would guarantee constancy of power upon which aeroplanes depend for stability. Most accidents to aviators, it is pointed out, may be due to failure of motors. Steam turbines also would provide power far in excess of anything now obtainable with gasoline engines, it is said, a factor vital to the Navy, since seaplanes are much heavier than aeroplanes for service over land.



The last word in artificial members



"Amputés" but cheerful workers



The mechanism of the elaborate "hand" for clerical and professional workers



Arm with crab-foot hand for mechanic



Steel bar arm for laborer



Five artificial hands in this merry gathering



Elaborate arm and hand for skilled mechanic

The Heavens in September, 1916

Comets That Have Been Trapped by the Major Planets

By Prof. Henry Norris Russell, Ph.D.

THERE is often occasion in these columns to comment upon the return of a periodic comet—though, with the great exception of Halley's Comet, these members of our system are inconspicuous bodies, of no great interest to the casual observer, if indeed they are visible at all without powerful telescopes. While therefore the individual members of this class often excite little interest, a study of the periodic comets as a group affords much that is worthy of the attention of any one interested in astronomy. A list of the comets known to be periodic, printed in the French Nautical Almanac for the year 1915, may well serve as our starting point. In this list are given particulars of the orbits of 65 different comets whose periods of revolution do not exceed a thousand years. To bring the test (which, as the Nautical Almanac must be published and available for the use of mariners a long time in advance, was published in 1913) up to date, we must add three more periodic comets discovered in 1913-16, making a total of 68.

Twenty-two of these comets have been observed at more than one return to perihelion, and their periods are accurately known. The other 46 have been seen only once—that is during a single approach to the sun, though often for several months during this visit. In such a case it is much more difficult to determine the comet's period. We can observe the comet over such a small portion of the whole circumference of its elliptical orbit that it would be quite hopeless to attempt to estimate accurately the extent of the invisible portion from our measures of the shape above the observable part. But fortunately, the velocity of motion of a periodic comet, at any given distance from the sun, is less than that of a comet moving along the same track (for the moment), but in a parabolic orbit which extends away to an indefinite distance; and by combining the information which our observations give us concerning the comet's track and its speed, we can predict with considerable accuracy the nature of the unobservable portion of its orbit, provided only that the observations at our disposal are sufficiently numerous and precise, and extend over a long enough interval of time. The longer the period, the smaller is the difference between the actual velocity of the comet and the "parabolic velocity" which it would have if moving off into space, never to return; and hence, while the observations of a single apparition may fix a period of six or eight years' length within a few days, observations of equal accuracy of a comet of six or eight hundred years' period will leave an outstanding uncertainty of from 20 to 50 years or more in the time at which it may again be expected. But, even so, there can be no doubt of the general correctness of the conclusion that the comet will return within a period which, viewed from the standpoint even of human history, is relatively short.

The known periodic comets, however, are by no means uniformly distributed as regards their periodic times. Thirty-seven out of the 68 comets—more than half of them—have "short periods" of between three and nine years, and two thirds of these periods fall between five and seven years. Of longer periods there are three of about 15 years, two of about 35 years, six between 60 and 80 years, two of about 120 years, nine between 200 and 500, and nine more between 500 and 1,000 years.

It is evident that there must be some good and especial reason why comets with periods of about six years should be so much more numerous than those which take longer to complete their revolution. One reason why there should be more on our lists is obvious—they stand a far better chance of getting observed. It is only during the past 150 years that comets have been observed with sufficient precision to make it possible to determine from the observations of a single apparition what the period is, even roughly. During this century and a half a comet of six years' period has returned to the vicinity of the sun 25 times and upon at least some of these returns the earth is pretty sure to have been in a good position from which to see the comet—that is, relatively near it, and so situated that the comet will be visible on a dark sky. Consequently

the comet has had several good chances of being discovered.

But, during this same interval, only one fifth of all the comets having periods of about 750 years will have returned to perihelion at all—the others being in the remote parts of their orbits, out of all possible chance of being seen—and many of those which do return will have been "unfavorably placed," and likely to escape discovery, no matter how vigilant a search might be made. And, after the comet has been discovered, unless it remains in sight long enough to permit the securing of numerous and precise observations, it will not be possible to tell whether it is periodic or not, unless the departure from a parabola is very pronounced, that is, unless the period is short. Taking all this into consideration, we see that, although, in our present list, the number of comets with periods between five and ten years is four times as great as that of those whose periods lie between 500 and 1,000 years, the disparity is in reality undoubtedly the other way, and the whole number of the comets of longer periods, including those which have no chance to be

which they now move. But how can this be determined without going through the exceedingly laborious process of calculating back for perhaps dozens of revolutions to see whether and when the comet and planet had an "encounter"? A very simple short-cut to the goal exists. If a comet has had its orbit changed in this manner, the new orbit, like the old, will pass very close to the point where Jupiter was at the time of encounter, and hence very near the orbit of Jupiter. The planet will move away, but its orbit remains substantially in the same position, and the close approach between the orbits of the planet and comet will be an abiding evidence of the comet's past history.

When the calculations are made, it is found that every one of the orbits of the short-period comets passes within 65,000,000 miles of Jupiter's orbit (with the exception of Eucke's Comet, which has the shortest period of all, and is in many respects anomalous), and that more than half of them pass within 15,000,000 miles of Jupiter's orbit. This is exactly what one might expect if they had in reality been captured. Those which had recently been added to the list would continue to pass very near the original point of encounter, while those which had been longer on their way since capture, exposed to the smaller but still quite perceptible perturbations arising from the attraction of the planets, even when not very near the comet, would have their orbits gradually shifted so that though no longer passing close to the original point of capture, they still went through its general neighborhood, and betrayed in this way their origin. Having found this satisfactory explanation for the existence of so many comets of short period the question naturally arises: Have the comets of longer period also been captured, in a similar fashion, by Jupiter or one of the other major planets? It is a matter of perfectly simple calculation to apply the same test to these comets that has just been described. In many cases it is found that the orbit of one of the comets of longer period passes close to that of one of the larger planets—usually Jupiter, sometimes Saturn, and rarely Uranus, and it is reasonable to suppose that in these cases the comet has been captured by the planet in question—the critical approach not having been as close as in the case of the short period comets, the influence of the planet's attraction less, and consequently the period of the captured comet longer. Jupiter, as ought to be expected, on account of his great mass and attracting power, is the principal agent in this process. Saturn is apparently much less efficient, and Uranus still less so, while no comet so far

investigated gives evidence of having been captured by Neptune. It does not follow, however, that Neptune is incapable of capturing a comet. A more probable explanation is to be found in this: After capture by a planet, a comet's new orbit will approach the sun to within a fraction of the planet's own distance, but usually not a very small fraction. Only two of the 37 short-period comets of Jupiter's "family" approach the sun nearer than one tenth of Jupiter's own distance, and the nearest approach of all is to 1-15 of Jupiter's distance. Hence, out of comets captured by Neptune, we would expect very few to approach the sun to within one tenth of Neptune's distance, or three times that of the earth, and practically none to come nearer to the sun than twice the earth's distance. Now all but two of Jupiter's family of 37 come nearer the sun than this last limit, and these two are but little outside. It is therefore clear that, if a comet was captured by Neptune, the chances would be very much against its ever coming near enough to the sun to get within the region where alone it would become bright enough to be seen.

The Heavens

At 10:30 P.M. in the middle of the month, as our map shows, we shall find the great cross of Cygnus nearly overhead, but a little to the west. Below it is Lyra, with the splendid star Vega, and farther down are Hercules and Corona. In the southwest is Aquila, high up, and Sagittarius, almost setting. Capricornus and Aquarius occupy a dull region in the southern sky.

(Concluded on page 228)



NIGHT SKY: SEPTEMBER AND OCTOBER

At 11 o'clock: Sept. 6.
At 10 1/2 o'clock: Sept. 14.
At 10 o'clock: Sept. 21.

At 9 1/2 o'clock: September 30.

At 9 o'clock: Oct. 7.
At 8 1/2 o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

seen for some centuries to come, must mount up into the hundreds.

But, even so, some reason must exist for the exorbitant number of comets with periods of about six years. The true explanation of this was realized fully a century ago. A fairly bright comet was observed in 1770, which, according to the calculations of Texell, had a period of only five and one half years, and hence should have been seen at later returns, but was never found. La Place, the great mathematical astronomer, showed, however, that in 1779 the comet had come very near Jupiter, and that its orbit had been completely changed by the attraction of the planet, so that afterwards it never came near enough to the sun to be visible. Moreover, on calculating backwards, he found that in 1767 the comet had also been near Jupiter, and undergone a great change in its orbit, and that before that date it had also moved in a path so far from the sun that it never grew bright enough to be visible. The comet had thus been "captured" by Jupiter in 1767, and made into a short period comet, because the net effect of the planet's attraction was to slow its motion, which necessarily, by the theory of gravitation involved making its orbit smaller—so much so that, in spite of the slower motion, it got around in less time than before.

There is good reason to suppose that all the other comets of short period have been similarly captured by Jupiter—that is that they were moving originally in much larger orbits, and, having at some time come very near the planet, and had their motion slowed by its attraction, have been diverted into the paths in

Strategic Moves of the War, August 25th, 1916

By Our Military Expert

THOSE readers of the SCIENTIFIC AMERICAN who have been consistent and gracious enough to follow the weekly analyses of the war will recall a certain penchant of the writer for assigning a very definite importance to the prospective movements of General Sarrail's forces on the Saloniki front. Action by these armies of the East has been forecast so constantly by military writers that the inauguration of the offensive comes rather less as a surprise than as perplexity at the beginning of an operation which the perspective on the great war, obtainable only in the United States, summarizes as being too long delayed.

But has it been too long delayed? Let us look.

Since the first days of August various small bodies of Entente troops have been constantly engaged in minor and local actions to feel out the solidity and extent of the dispositions for defense which have been made by the Central Empires. These general and deliberate reconnaissances have gradually become changed into major operations, which, beyond a shadow of a doubt, mark the beginning of the Balkan offensive. First, the Serbians, who hold the left of the Entente line, pushed forward in comparatively weak strength—merely the advance elements—and gained a little ground which was not desperately contested, then were pushed back upon their following main bodies, where latest reports indicate the lines are closing in battle.

In the center the Franco-British forces thrust northward along the Vardar valley. Some days ago the Doiran railway station was taken by them, and the center has since gained some ground of indeterminate depth beyond this point.

On the east the troops of General Sarrail crossed the Struma River and, although the Bulgarian forces in increasing numbers crossed the Grecian frontier, taking several unimportant towns and old fortified places to meet the thrust, his soldiers seem to have secured a firm footing on the inimical side of the stream.

Newspaper reports, emanating mainly from Teutonic sources, allege that tremendous individual pressure has been brought upon members of the Roumanian administration to influence immediate declaration against Teutonia, through monumental bribes and the blandishments of fair women. Whether these allegations be true or not is somewhat beyond the province of things military—except for the facts that diplomacy has, to date, dominated the policies of the Balkan States—and that diplomacy goes hand and hand with war in its more intimate aspect. Probably the charges are true, but they would be just as true for one side as the other, and all is counted most fair in war. The meat of the item is to be found in the question whether or no Entente diplomacy has prevailed.

This Balkan offensive has been expected for so long that students of the war have been sorely puzzled as to the delay in its inauguration. The most logical answer to the query seems to have been found in the credible opinion that Entente diplomacy had arrived at so thorough an understanding with Bucharest that Roumania at last was willing to pay her price in treasure and men for the acquisition of greatly desired territory contiguous to the state, allied with it in blood, custom and desire of its people. The great, vulnerable flank of Austria stretches for more than four hundred miles across the Roumanian border; Austria, involved with Italy on the west, tremendously weakened on the east by losses in killed, wounded and prisoners, amounting to more than eight hundred and fifty thousand, inflicted by the Russian offensive, must be—greatly reduced in reserves. The lines in Volhynia, Galicia and Bukovina are tenuous; and if it be asked that they extend for more than four hundred miles additional to the present line of occupation, to meet a Roumanian threat, their lot must indeed be an unhappy one. Figuring that if Sarrail's offensive start and immediately involve all possible Teutonic forces of Bulgars, Germans, Austrians and Turks to meet seven hundred thousand men, except the forces which have been held inactive to oppose a possible threat across the Bulgarian-Roumanian border, there

must remain a great unguarded strip in the Teutonic line which is coincident with the Roumanian-Austrian frontier. If, then, Roumania can be persuaded to strike at this vital point, with its tremendous threat to the Kaiser's communications with his Asiatic ally, while the principal forces are involved on the Macedonian front, the chances for prompt allied success are monumental. Or, if Teutonic forces are shifted to meet the Roumanian threat, one or more fronts must be weakened, the Russian, the French or the Macedonian, then the task of the seven hundred thousand to win back Serbia and sever Asiatic communication becomes easier. The alternative remaining in the Central Empires is to throw into the breach the priceless reserves which remain within Teutonia proper. The time for the stroke seems to have been figured out unimpeachably—if Roumania comes in.

The beginning of the allied Balkan offensive therefore implies one of two things:

Roumania has decided to throw in her lot with the Entente. In this case a few days will witness developments of moment and the legions of Roumania will be pouring westward and southward, perhaps before these lines see print.

Secondly: Roumania has definitely decided to remain neutral. If this be the case, it is so clearly understood at Entente headquarters that it is realized there is no remaining hope of assistance to be had from there and, not to lose the advantage of the great eastern and western offensive by a possible reverse,

approach directly upon Bulgaria, suffers under the handicap of communications, for there is no railway up the Struma valley, and all-important supplies must be transported by wheeled transportation over indifferent roads. The route through Monastir is a little more hospitable, for a railway runs through Florina to Monastir; but it finds its terminus at the latter point.

The third—the remaining—line of attack lies along the valley of the Vardar. Here the main line of the railroad from Saloniki to Nish, to Belgrade, to Austria, forms a sure artery of supply for a northward thrust; and it is here the main attack must be made. Logically, there is no alternative.

But the way is difficult, a veritable modern Thermopylae. Towering and forbidding mountains bar the passage; where the valley winds through the grim ranges it is only through more or less narrow passes where a handful almost may defy a multitude. And in the gaining of these passes, if gained they are to be, a superior artillery must batter the passageway; guns, and guns alone, may here conquer.

It may be that the collection of this artillery has had great bearing upon the seeming tardiness of the attack. Field guns are for defense and open ground fighting, but it calls for the big fellows to batter emplacements. These big guns wear out, and eat shells by the ton; should the supply of either fail at a critical moment, the day might easily be lost. It seems as though the Entente has been unwilling to move until all things are fully provided for.

Without a doubt, the most interesting theatre of war in the near future is to be found in the Balkans, and it will well repay the observer to devote considerable attention to the already begun campaign in the locality.

Moving a 1,100-Ton Brick Railway Station

As a part of the double-track system which the Southern Railway is now proceeding with between Washington, D. C., and Atlanta, Ga., a distance of 649 miles through the Piedmont section of the South and along the eastern slope of the Blue Ridge and Allegheny Mountains, the wonderful concrete double-track viaduct across the

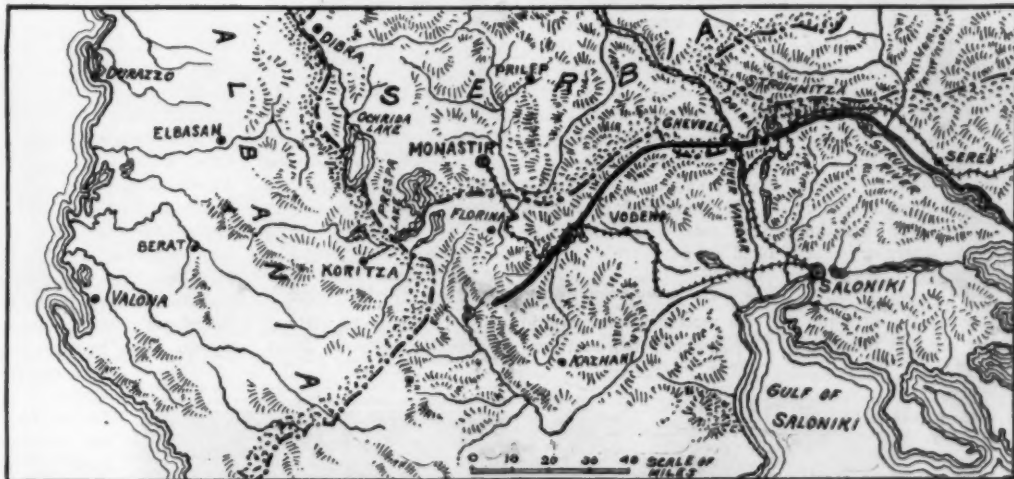
Dan River at Danville, Va., stands out with prominence.

The above improvements in and around Danville will represent an outlay of about \$1,700,000, according to the railroad company, and will provide for a modern double-track railroad. The bridge, as well as the double-track line running north and south of the town of Danville, has been completed and is now in successful service.

A difficult engineering feat in connection with the improvements at Danville was the moving of the entire Southern Railway station from its former location to its permanent new location, a distance of over 50 feet, across a street. This passenger station is a brick structure weighing 1,100 tons, and it was obviously a difficult engineering feat to move it intact to its proper place alongside the new double-track line. This has been accomplished, however, keeping the station in condition; and a few finishing touches and some fresh paint will make the station ready for use again. The moving of the station, instead of tearing it down and building it over again, was found to be more economical and also more expeditious.

Over 65 per cent of the double track of the Southern Railway between Washington and Atlanta has now been completed and is in actual service. The entire distance from Washington to Charlotte, 380 miles, will be completely double-tracked in six months. The line between Charlotte and Atlanta is, for the most part, under contract, and some of the double track is already in use.

To double-track this long line, reducing the grades and cutting out many curves, is a big undertaking, as the line runs along the foothills of the Blue Ridge and the Allegheny Mountains, and at some places the work is very heavy, particularly in the vicinity of Mount Airy and Toccoa, Ga., which is one of the most mountainous sections through which the main line from Washington to Atlanta passes.



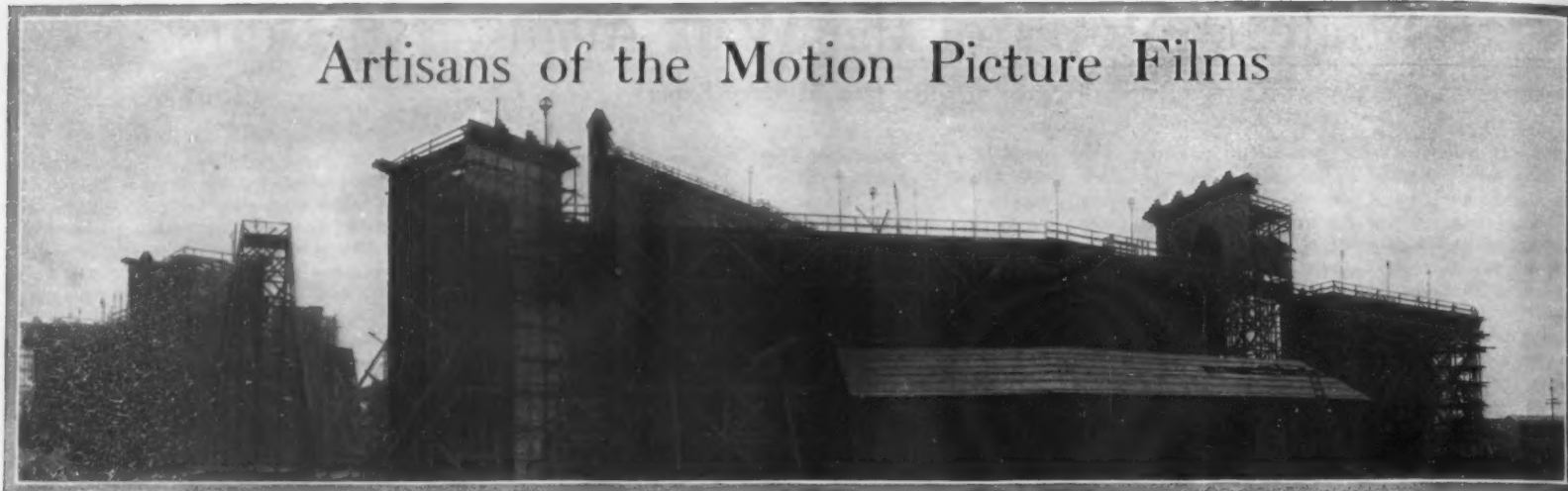
The theatre of the war in the Balkans

there remains no longer a reason for postponing the venture against the present holders of all Serbia. The answer should be obvious. It is most unlikely that the Entente will permit further wavering on the part of Roumania, if she wishes any of her territorial chestnuts pulled from the fire of the war. Either Roumania must now come in when the situation is most propitious to the enemies of Teutonia, strike her deadly blow and win for herself the desired lands, or she must be content to remain in statu quo with no hope of emolument later for mere passive indorsement of the Entente. Roumania may gain her price now; she will certainly not be permitted later, when the inexorable law of arithmetic as expressed in two-to-one manpower has prevailed a year or two years hence, to enter the conflict on the obviously winning side and smugly demand recompense for services which were not needed under the then existing conditions. As it now seems, only a stupendous Teutonic diplomatic coup can prevent Roumania from entering the war within a short time.

The military situation shows a Teutonic response to what is apparently the main Entente thrust through the center, by synchronized attacks upon General Sarrail's flanks, a hundred and fifty miles apart. Should the attack in the center succeed, and the Teutonic attacks upon the flanks as well, the position of the battle lines would resolve itself into the formation of a huge salient, with the existence of a threat from either side to communications from Saloniki. Were the forces anything like equal, this threat would be more serious than it is; for it is to be doubted whether more than 200,000 Bulgarians, 100,000 Turks and 150,000 Austro-Germans, 450,000 in all, can be massed to meet the attack of 700,000.

There are three possible avenues of attack available for the Entente: one through Monastir, one along the valley of the Vardar, one through the valley of the Struma. The last, while offering an inviting line of

Artisans of the Motion Picture Films



THE audience is tense with excitement as the hero in the film play struggles frantically with the control apparatus of a submarine that is fast sinking to the ocean bottom, because of the constantly rising water in its hold. And as he struggles at his post the water pours in on him through an ugly gash made in the conning tower of the craft by an enemy destroyer. Perhaps it is the climax in a gripping drama; then again, it may be the big scene or "punch" in a hilarious comedy. But however that may be, the realism of the scene has had the desired effect on the audience. What dangers these motion picture folks incur in their daily work! is the general comment of the public.

Several months ago the scene in question was acted, not, as might be supposed, in the interior of a submarine, but in a quiet corner of a motion picture studio. The "submarine" was an elaborate structure of wood, metal, and plenty of paint, life-sized to be sure, but only of a sufficient length or depth to represent the particular compartment portrayed in the picture story.

For weeks the artisans of the studio workshops had worked in building this pseudo submarine; and before the camera crank was turned the technical director had gone over every detail of its construction to make sure that it emulated successfully the interior of a modern submarine. Then the studio hands built a tank around the scenery. The "set," as the scenery for a studio scene is called, was now ready for the director.

The director, being unable to carry out his program of photographing certain outdoor or "location" scenes on a certain day because of rain or poor light, decided to stay at the studio and photograph the interior scenes called for in the scenario or working plan of his picture. After rehearsing the action of this particular scene several times, the lamps flashed up and the cameraman took his place by the side of his camera. At the command of the director one of the stage hands climbed up on the deck of the "submarine," pulling a heavy hose after him, which he placed in the opening of the conning tower. The water was turned on, and it flowed through the hose and passed down upon the back of the actor playing the part of the hero-

sailor struggling with the control mechanism of an underwater craft. The water, bounded on all sides by the improvised tank of wood and rubberized canvas, slowly arose in the "submarine" interior. The camera, which all the while was recording the action, was naturally so focused as to take in only the desired portion of the setting—the sides of the tank did not show in the film. The scene was a success.

Typical of the striving of all American producers for realism is the foregoing instance. A half dozen years ago the audience of the average picture house was not as critical as the audience of to-day. Formerly, a director depended solely upon a good story and fair acting to make a film production a success; whereas to-day the director strives to reinforce these two essentials with utmost realism of scenery. It is imperative, claim the producers, that the pictures should be replete with realism: the audience must not be permitted for a single moment to recall the fact that after all the scenes are but improvised backgrounds and the necessary pieces of furniture taken from the stock room or property room of the studio. In brief, the audience must be made to forget the mechanical end of picture production; and to this end every effort is made to have even the most insignificant details accurate and confidence-inspiring.

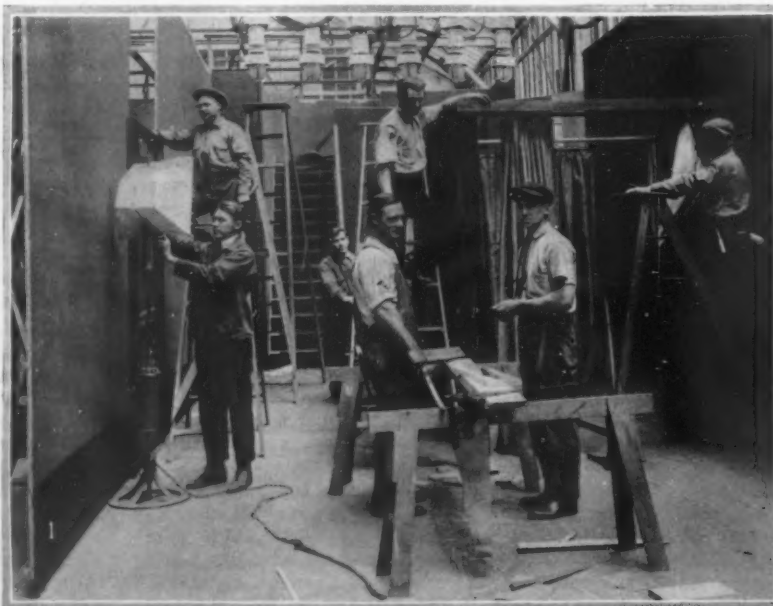
Jacks—and Masters—of All Trades

No motion picture studio would be complete without its carpenter shop and staff of expert workmen. There

are so many things that must be built especially for the pictures that a complete equipment of woodworking and metalworking machines and a skilled gathering of artisans are an absolute necessity.

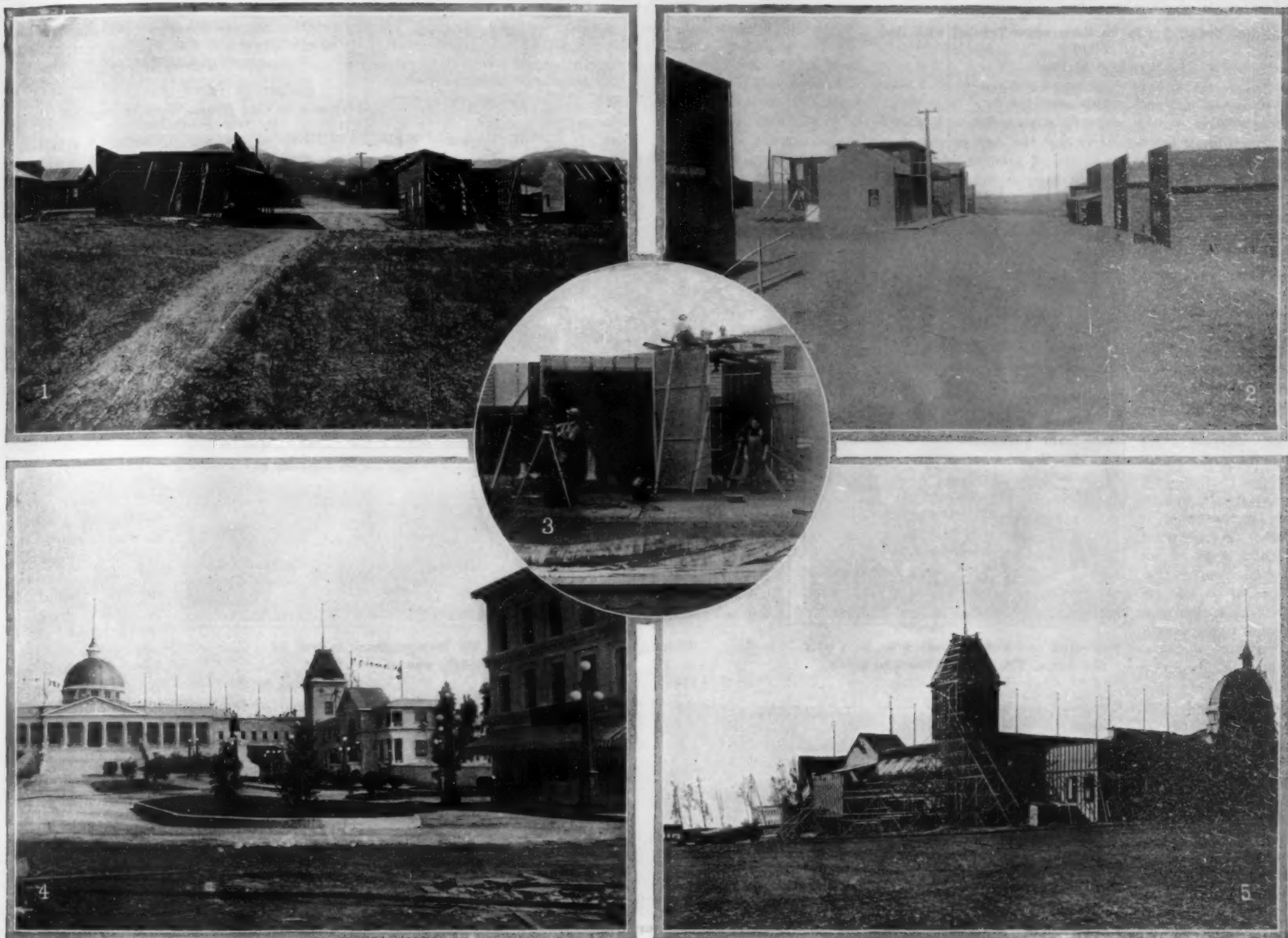
It would be impossible to describe with any pretense to thoroughness the range of work turned out by the studio workshops. It is only by offering a few examples of what they do regularly that a general idea of the scope of their toil can be gained. One day they may be building a safe of light wood or compressed paper, accurately made even to the bolt mechanism, which may bring forth roars of laughter from an audience, months hence, when it is dropped on the head of one of the comedians in a film play. They may be called upon to build an aeroplane, closely following the lines of a genuine machine that is to be used in the scenes of actual flying. The workmen may perhaps put in one or two weeks' work in building the aeroplane, exercising much ingenuity in its construction. As likely as not the tires of the landing gear may be made from short lengths of rubber hose or canvas tube, filled with sawdust. And the same degree of ingenuity may be repeated a dozen times or more in the construction of the machine; all this work to appear for a few seconds on the screen, and probably doomed to be blown to pieces or burned to ashes. The men may turn to the construction of a mirth-provoking hose-cart or fire-wagon for the fire department of some imaginary rural community. Again, historical or period plays usually mean much work for the studio artisans, for it is often necessary to construct all manner of things that cannot be purchased in the open market. It is no uncommon occurrence, therefore, for them to turn out a replica of the first steam-boat, an old-time stage coach, or even a Roman catapult. All these things are in the day's work.

In the current war play, "The Fall of a Nation," four huge siege guns figure conspicuously in the battle scenes between defenders and invaders. Each gun is a faithful reproduction of the famous Krupp 28-millimeter siege howitzers, mounted on caterpillar wheels. On the screen even a military man would be apt to mistake the guns for their counterpart



The ways and means of preparing the sets in a motion picture studio: The artisans at work, the furniture room, and their workshop

1. Carpenters, stage hands and electricians at work constructing a set that is to represent the back room of a saloon. The walls are built of framework, held in place by props and covered with compressed paper board. 2. Part of the furniture or "prop" room of a typical studio, showing the variety of material. 3. The woodworking shop of a Western producer.



In the land of two-dimensional structures: Typical examples of elaborate outdoor sets

1. A group of fifteen structures made to represent a small town along the Mexican border. Note the manner of propping up the walls of the houses from within. 2. The same town completed. By properly focusing the camera down the center of the town, not a vestige of props remains in the recorded pictures. 3. How the film artisans produced an artificial thunder shower: a garden set was erected on the roof of the studio, a wooden trough with holes was placed over the set, and an aeroplane propeller driven by an electric motor was used to supply the wind. The water, poured into the trough, fell in drops on the set, only to be blown violently by the hurricane created by the propeller. A flashlight was set off at the propitious moment to simulate lightning. 4. A mythical government seat erected by a film producer in the foothills of California. 5. Rear view of the same set.

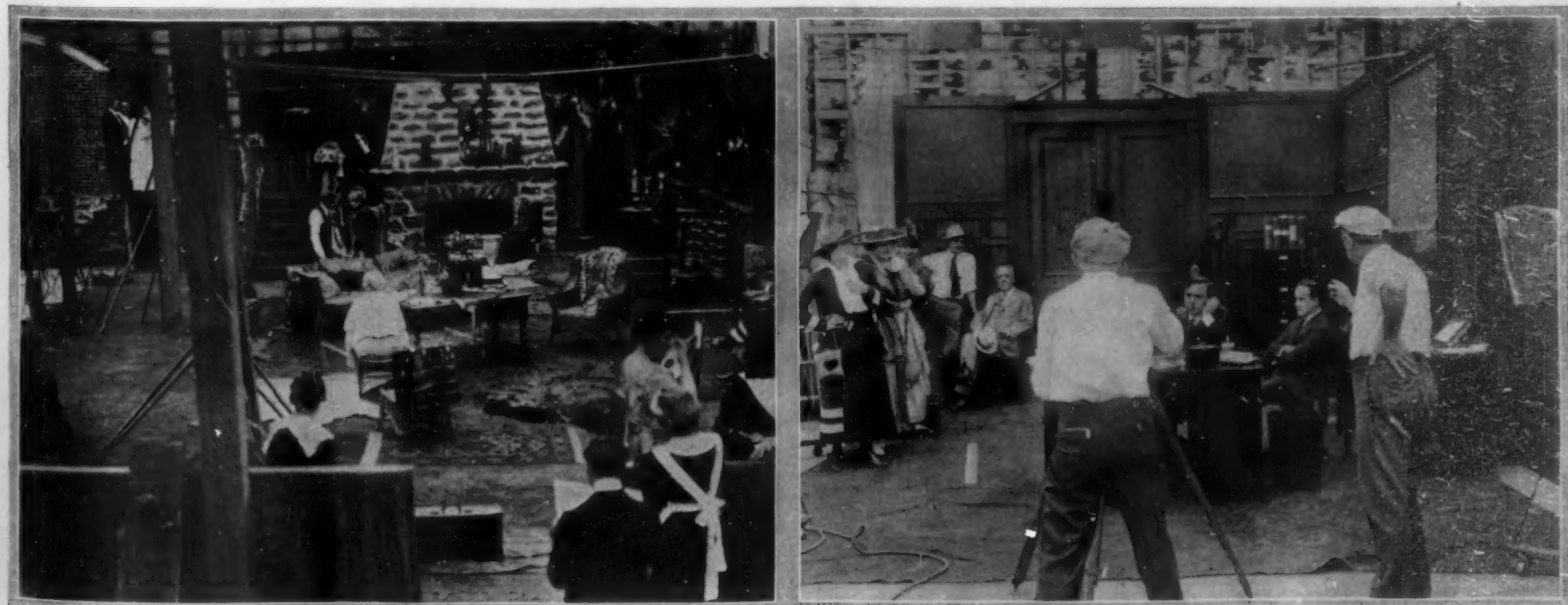
busily engaged on European battlefields. As a matter of fact, however, these "guns" are made of wood and represent perhaps one of the most intricate pieces of work yet turned out by the film artisans. They are a faithful copy of the actual pieces, even down to the recoil cylinders which actually work. It is stated that these guns cost the producers of the film some \$10,000 each, and although the amount appears rather high, nevertheless it serves to accentuate the great amount of preliminary research work and designing that had to be carried out before the actual construction began. And here again the producers insisted that if the guns were to be used at all, they must be accurate enough

to pass before the most critical audience without arousing undue suspicions.

The producer of a submarine story which, in its main essentials, closely follows the theme of Jules Verne's "Twenty Thousand Leagues Under the Sea," recently endeavored to secure the loan of a United States submarine from the Navy without success, so the story goes. Whereupon he set out to build a submarine of sheet iron, with a length of over 100 feet, a beam of 15 feet, and a draft of 4 feet. The shell had to be of sufficient strength to withstand a submergence of 40 feet deep. By means of tanks the submarine could take on water in order to settle down beneath the

waves, while compressed air tanks permitted of blowing out the water ballast when the craft was to be brought up to the surface again. The submarine was fitted with a torpedo tube capable of discharging a regulation torpedo. In all, six months' time was expended in the building of this submarine, which closely followed the lines of the *Nautilus*, the famous craft of Capt. Nemo; indeed, the Navy submarines were hardly suitable to represent the *Nautilus*, which may be one reason why the producer decided to construct a special submersible, fitted with a lock in its bottom through which divers in self-contained suits could pass out to

(Concluded on page 224)



Typical examples of interior settings erected in the studios of two Eastern producers

At the left: The living room of a country home. Note how the stairs terminate at the extreme left in simply a wooden platform, on which stand the players who, according to the film story, are in the upper part of the house at that moment. The suspension of the chandelier on a wooden beam is also interesting. At the right: An office set, showing the erection of two sides only to furnish the necessary background to the picture.

Perfecting a Fire-Proofing Solution Cloth and Wood Refuse to Burn when Treated with this Fluid

By Ival McPeak

AN application is now pending for a patent on a new fire-proofing liquid. This addition to a large number of similar products now on the market is justified by the claim of the inventors that the new preparation absolutely fire-proofs all kinds of inflammable materials, that it can be applied cheaply and when once applied need not be renewed, and that it increases the durability of materials and lengthens their life of service.

A pharmacist at Badger, Iowa, is the originator of the preparation. He first became interested in the possibilities of fire-prevention when some promoters of fire-proof paint stopped at Badger and tried to induce him to purchase a stock. It occurred to him that if an outside application of paint could retard combustion temporarily, it should be possible to manufacture a liquid which, soaking into wood or paper, would fire-proof the material throughout. He began to experiment immediately and after 17 months announced that he had discovered a perfect fire-proofing solution. But to make sure that his preparation would stand all scientific and practical tests, he came to the University of Iowa school of pharmacy, where he had formerly been a student, and enlisted the aid of the dean and one of his old professors. The three experimented upon the liquid in every possible way, subjecting it to the diverse conditions under which a fire-proofing preparation might fall in practical use, and making necessary minor alterations in its composition. At length, it was possible to announce the discovery of a preparation entirely practical, sound scientifically, and reasonable in price.

Fire-proofing paints and liquids heretofore on the market have been unsatisfactory chiefly for two reasons: they held combustion in check only temporarily, or were too costly for everyday use. Certain mercury and zinc salts, zinc chloride, for example, will prevent combustion, but mercury salts are expensive and zinc chloride absorbs moisture from the air and is easily washed out by rains. "Double-dipped" preparations were usually too expensive.

The new compound has none of these objections. When materials are saturated with this liquid, the moisture dries out, leaving an insoluble mineral substance in the cells of the fibre. This mineral cannot be washed out by any amount of water, and it entirely

prevents combustion. The chemical "trick" has been to combine fire-proofing salts already known with other substances to form an insoluble compound in which, as it were, the fire preventive is imprisoned.

In the demonstration of this fact, one experiment consisted of taking a half-inch pine block, saturating it with the liquid, drying it thoroughly, then placing it under running water for 24 hours. It was dried again and held for one hour over the flame of a Bunsen burner, which has a temperature of between 700 and

fire-proof. Even gun-cotton would not burn or explode.

The fire-proofing preparation is a little heavier than water; its specific gravity is 1.15. It smells slightly of (Concluded on page 228)

Safety in Sand-blasting Operator in One Room, Blast in Another By Joseph Brinker

PREPARING metal surfaces for a covering of paint has given rise to extensive use of the sand-blast, especially in the large-production automobile factories.

When the outfits are constructed of sufficient size to accommodate large surfaces such as mud guards, hoods and bodies, the problem of protecting the workmen has presented serious difficulties. Various forms of safety devices for the operators of the sand-blast nozzles have been tried, including the familiar respirator with a sponge through which the operator breathes, and various forms of helmets similar to a diver's dress, in which fresh air is supplied under pressure. The first renders it difficult to

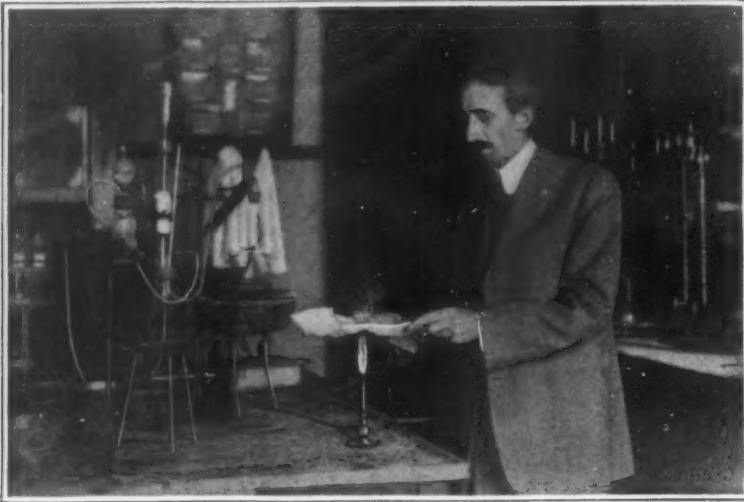
breathe; the second type is often so cumbersome that it is discarded by the workmen at their own peril. In fact the history of the use of safety sand-blast devices has proven conclusively that when these may be used or detached at will by the workmen, they are usually discarded, even if such neglect constitutes positive danger.

This difficulty has been overcome in the apparatus pictured herewith in which it is necessary for the operator to use the safety helmet if he is to work at all. Each sand-blast room is a small compartment of the double hopper type in which the heavy particles of the sand used in the cleaning process are drawn out of the lower hopper and the lighter particles out of the upper by air suction. The material to be cleaned is laid on a grating between the two hoppers. It is introduced into the compartment through a door at one end. The sand-blast operator's

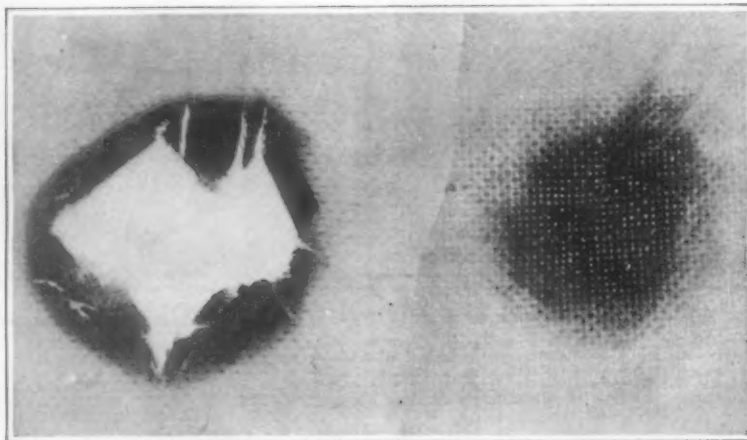
head-dress, which is of canvas with a fine-mesh copper screen at the front, is securely attached to the inside of a curtain which forms the front wall of the compartment. This curtain is fastened to sliding metal doors which can be moved horizontally from side to side. In this way, it is impossible for the operator to see into the interior of the compartment until he puts his head in the helmet. This being accomplished, he stands on the floor outside the compartment, moving along as is necessary in the progress of his work by pushing the sliding metal doors to either side with his elbows, as shown below.



Untreated and treated gun cotton held over the flame. The latter refuses to ignite



Holding a treated cloth over the Bunsen flame to test its combustion-resisting powers



Untreated and treated cloth after exposure to Bunsen flame. The latter is but slightly charred; its substance is intact

1,000 deg. Fahr.—a much greater heat than is developed in a conflagration. The wood was not burned, only charred slightly where the point of the flame had struck it directly. A similar block, untreated, was consumed to ashes in exactly nine minutes. A rag was treated with the liquid and kept under running water for eight days, but at the end of that time could not be made to burn. An interesting test was to dip half of a sheet of paper in the preparation; the paper was ignited and burned freely until it reached the treated half; the flame then died out. All other samples treated—wood, cloth, paper, excelsior—were alike rendered



The old style sand-blast

The operator is free to discard his headgear when he finds it cumbersome



New sand-blast (outside)

The operator must put his head in the protecting mesh to see his work



New sand-blast (inside)

Operator stands outside the little cage and works inside it

A New Method of Refrigeration

By William H. Easton

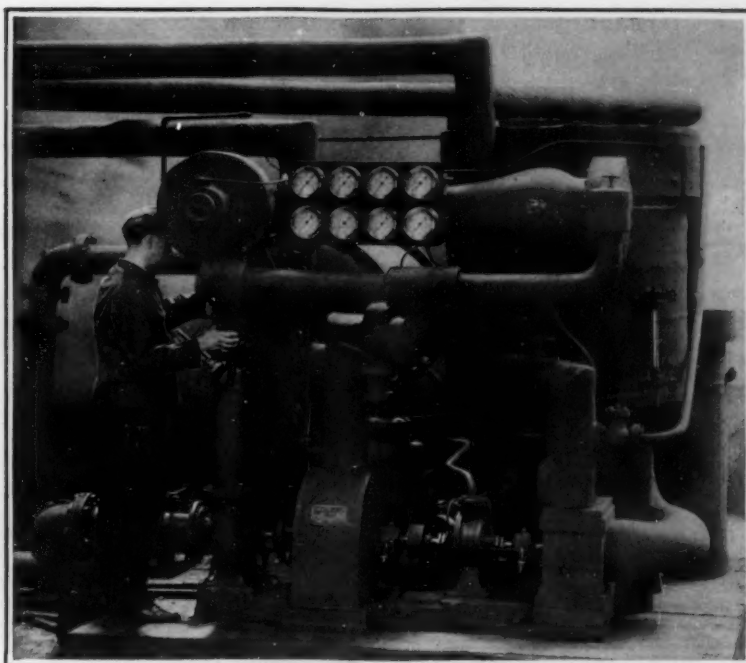
THE usual present practice in refrigeration is to employ an easily compressible gas, such as ammonia, carbon dioxide, or sulphur dioxide, liquefy it under pressure, and after cooling allow it to vaporize under reduced pressure. The heat for this vaporization is absorbed from the surrounding medium, usually brine, which becomes very cold and is used as the actual refrigerant.

A newly developed system of refrigeration, however, differs radically from this by using neither a gas nor high pressures, but produces low temperatures solely through the evaporation of water. This process, though, is far from novel; it is in fact a reversion to ancient principles, for the earliest known method of cooling water is to place it in a porous vessel which is set in a draught of air; small portions ooze through the pores and in evaporating at the outer surface draw heat from the water that is left and reduce its temperature. Only one improvement is introduced in the new system: the water is evaporated in a partial vacuum instead of at atmospheric pressure. At a pressure of 14.7 pounds per square inch water boils at 212 deg. Fahr.; but it boils at 45 deg. Fahr. under a pressure of 0.147 pounds and at 32 deg. Fahr. under a pressure of 0.0886 pounds. Thus by reducing the pressure, the rate of evaporation and consequently the rate of cooling can be greatly increased.

A number of attempts have been made in the past to apply this well known principle, but they have all failed for want of a suitable air pump that would maintain a sufficiently reduced pressure continuously. The success of the new system rests on the centrifugal air pump invented several years ago by Maurice Leblanc and which will be described later.

Briefly the operation of this refrigerating machine is as follows: Brine is drawn from a reservoir into a large vessel, called the evaporator. At the top of the evaporator the brine passes through a perforated plate and falls as a fine spray. The pressure within the evaporator is maintained at a low point so that a large part of the spray evaporates at ordinary room temperatures. The heat for this evaporation is drawn from that part of the spray remaining liquid so that the brine that collects at the bottom of the evaporator is very cold. This is pumped out and distributed to make ice or for other refrigerating purposes and is returned finally to the brine reservoir to go through the cycle again.

It is obvious that the water vapor formed in the evaporator must be removed or the pressure would rise and stop the process. This removal is effected by means of a steam jet of high velocity, which sweeps the vapors out of the evaporator into a condenser (of either the jet or surface type) where everything is condensed and removed by a pump. A study of the diagram, Fig. 1, will make clear



Refrigerating machine which depends upon the evaporation of water

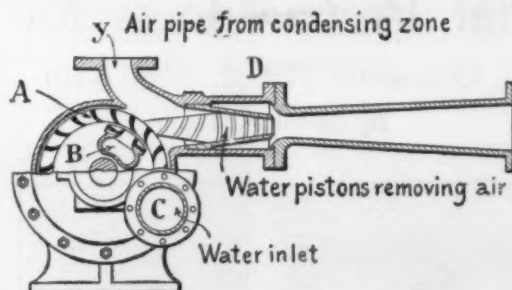


Fig. 2. Enlarged view of the pump

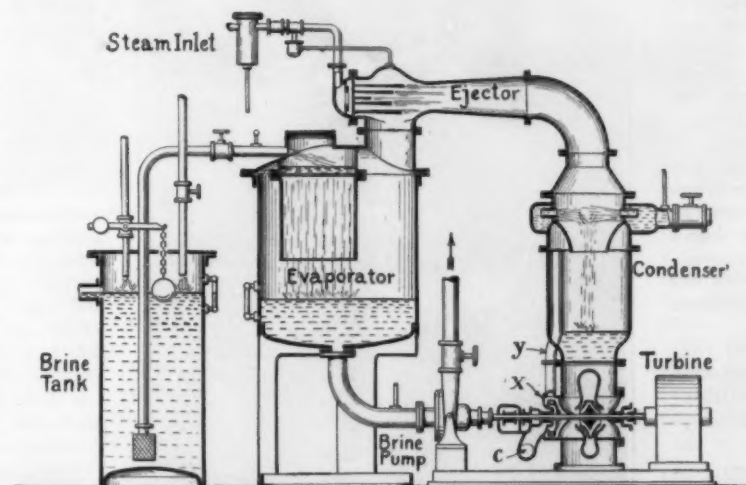


Fig. 1. Diagrammatic arrangement of the refrigerating machine using jet condenser

the details. The type of machine shown, with a single steam jet, does not reduce the temperature of the "brine" (in this case merely pure water) below 32 deg. Fahr., and is used mainly for cooling water or air. Where temperatures lower than this are required, as for ice making, two steam jets in series are used and the brine employed is an actual salt solution.

The air pump, which is shown at X in Fig. 1, and is enlarged in Fig. 2, has to maintain low pressure throughout the whole system against leakage and the tendency of the steam jet to raise it. From Fig. 2 it will be seen that this pump consists of a rotating impeller, A, which runs within a casing similar to that of a centrifugal pump. This impeller draws water into the chamber B through inlet C and forces it out through cone D in a series of layers or pistons. Between these water pistons layers of air are imprisoned from inlet Y, thus reproducing the action of the mercury pump, the most effective vacuum pump we possess.

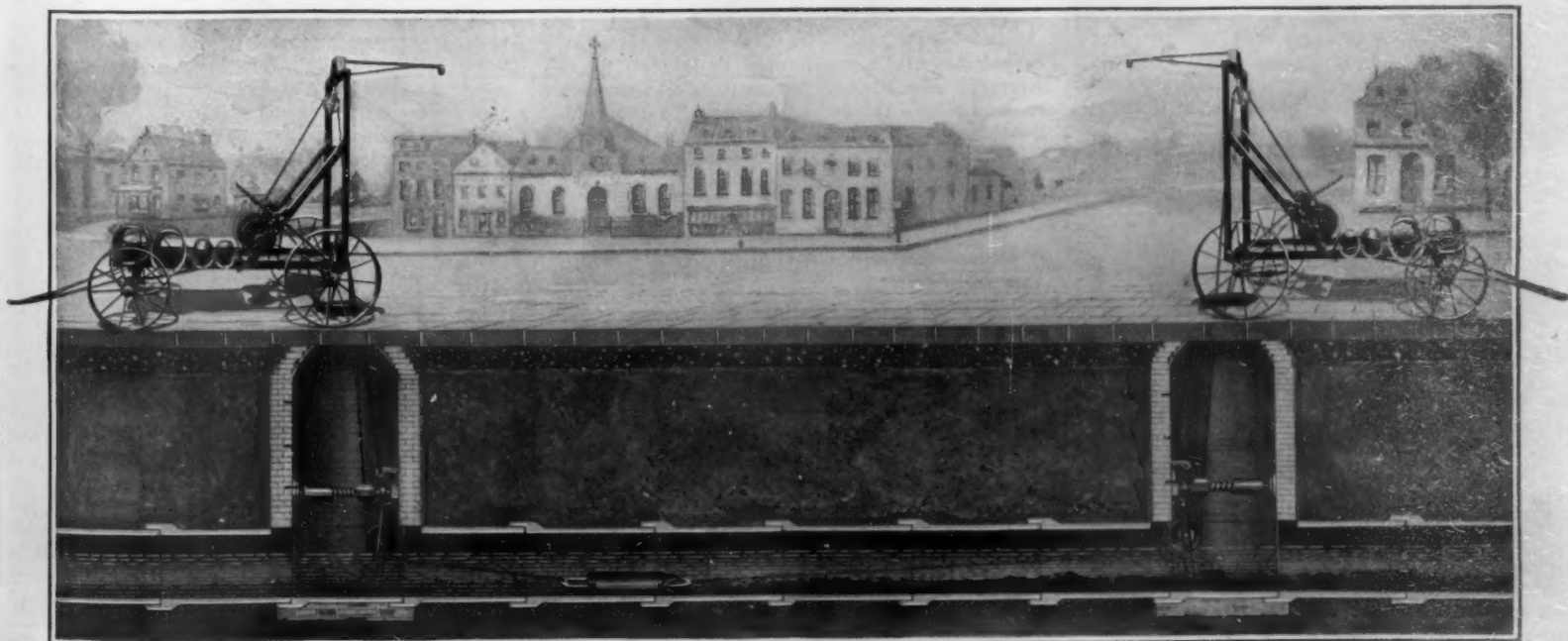
One of the obvious advantages of this type of machine is the elimination of a dangerous gas carried at high pressure. Explosions of ammonia or carbon dioxide tanks take place occasionally and not only cause great damage but make rescue work very difficult. For vessels, and especially war ships, this point is of great importance. If a tank containing gas at 600 pounds per square inch pressure is struck by a projectile the resulting explosion will cause about as much destruction as a shell. Furthermore, if the supply of gas becomes exhausted for any reason, it might be very difficult under certain circumstances to renew the supply.

An Efficient Sewer Cleaner

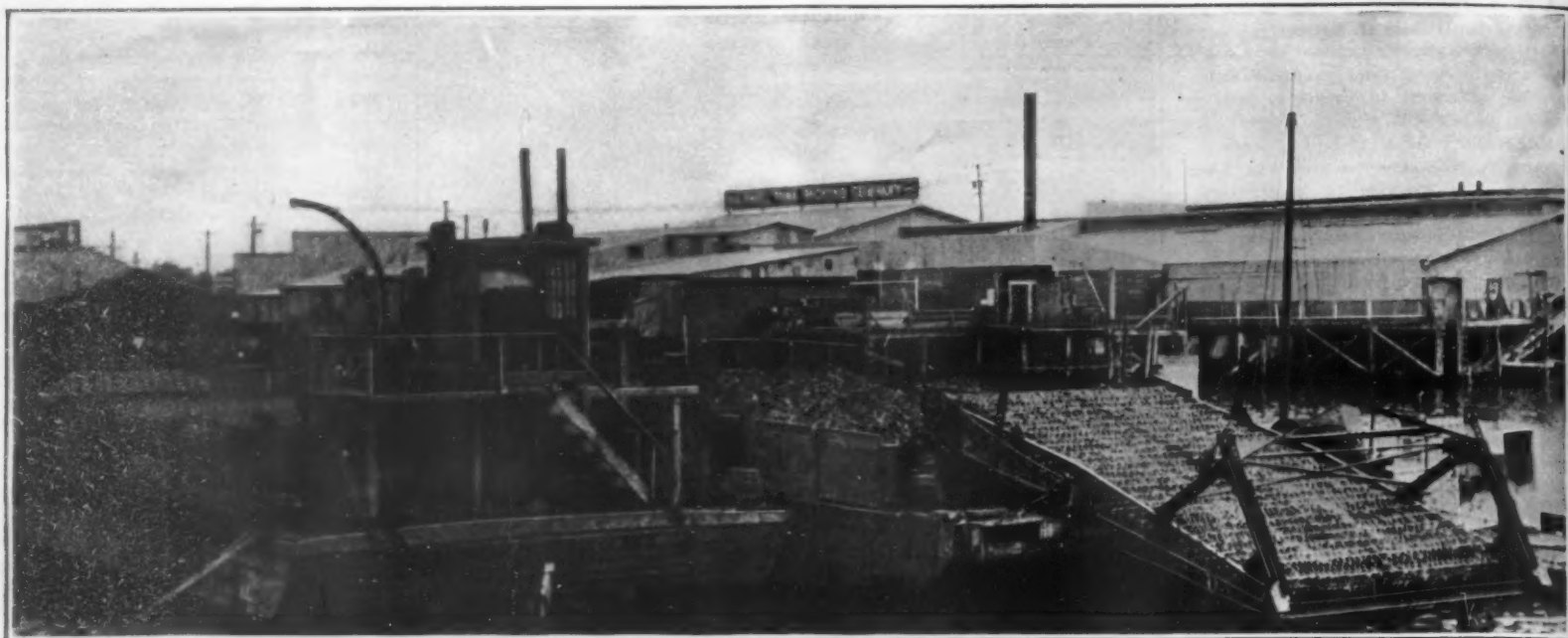
WE illustrate herewith something new in the way of sewer cleaning apparatus, from Hammond and Gary, Ind. It will be seen that the apparatus is set up at two adjacent manholes, and consists of an expansion bucket, with means for drawing it through the sewer.

The bucket used is of a very special type, closing automatically when the direction of the pull is changed. Hence it is not necessary to pull it through from one manhole to the next. It is drawn into the sewer only far enough to be filled with the deposit, and then drawn out of the same manhole into which it was inserted. Further, there is a device attached for guiding the bucket up the center of the manhole, so that it will not scrape away the sewer work or spill out part of its contents.

The buckets are furnished in five sizes, from 8 inches up, so that the apparatus is suitable for use in practically any sewer. The City Engineer of Gary states that he has cleaned a number of sewers which were in very bad condition, being filled with sand which he was unable to flush out with a fire hose, or remove by any means whatever till this machine was used.



An efficient substitute for the long-handled man-power slop-bucket



A kelp harvesting machine docking with a full load

Industrial Preparedness for Peace

Obtaining Potash from Kelp

By Monroe Woolley

EVER since the outbreak of hostilities in Europe the newspapers and magazines of this country have been replete with articles bewailing the demoralization caused in various American industries by the cutting off of the German potash supply, and speculating as to the possibilities of producing this commodity in the United States. Many lines of business are affected, but none to such an extent or with so great publicity as that of the growing of crops. The most superficial reader must have had his attention drawn to the fact that K_2CO_3 , KCl and KOH form the basis of fertilizing agents which are vital to the pursuit of agriculture on a scale of any magnitude; that for years the American farmer has been dependent upon Germany for his supply of these compounds; that the cutting off of this supply by the war has caused serious embarrassment to the consumer, acute famine conditions in the chemical trade, and desperate efforts to develop an American potash industry. Every conceivable source of supply for these invaluable potassium compounds has been canvassed, and wherever raw materials are available either commercial production or experiment looking toward it has sprung up.

The discussion of this vital question is never complete without mention of the occurrence of potassium salts in seaweed. It is well known that large quantities of the compounds of this element are present in the vast beds of kelp floating on the waves of the Pacific, close to our western littoral; that each year the waters of the Pacific coast are producing a crop that, could it but be harvested, would run in value from one hundred to one hundred and fifty millions of dollars, and make us totally independent of all external sources of supply. A dozen companies are accordingly now engaged in the campaign to wrest from Mother Nature her secret of how to extract the potash profitably from this oceanic vegetation, and make it available for use in agriculture and the arts.

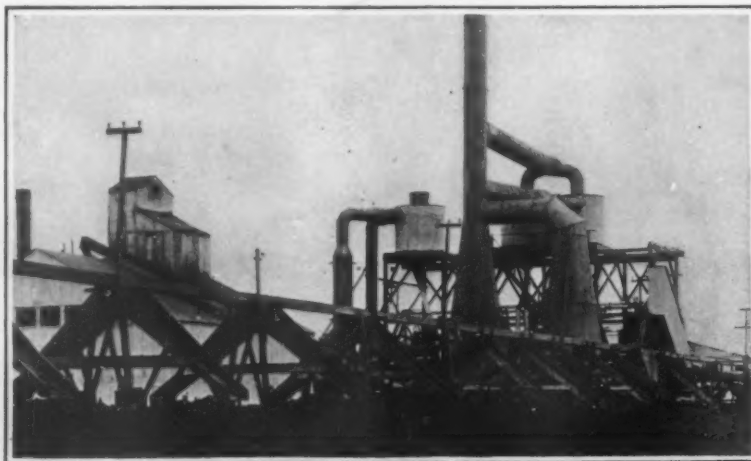
Although there are several plants in operation or under construction in the northwest—at Seattle, for instance—the greater part of the Pacific coast kelp beds lies along the shore of southern California between San Diego and Santa Barbara, and the percentage of potassium at present available in this locality far exceeds that given up by the kelp from farther up the coast. The thriving city of Long Beach is becoming the headquarters for the infant industry in this region. Los Angeles and San Diego are also interested in the work.

Little or no exact information is to be had as to the actual processes employed and the present status of potash extraction. Perhaps the secrets of no new industry were ever more carefully guarded. If the Germans have been mute about their aniline dye processes, the Americans engaged in the manufacture of kelp potash have been painfully so. Of



Growing kelp afloat in the Pacific

course, there are government publications on the subject; but even these cannot be comprehensive when those who are financially interested in the subject treated refuse to divulge what they have learned.



Plant for chemical treatment of the kelp, with dump-pile in foreground

The reason for this attitude is a simple one. The companies which have entered this field have been obliged to undergo a heavy initial expense for experimental and research work in the development of their methods, and are naturally anxious to conserve for themselves the benefit of these expenditures. But it may be stated without reserve that processes have been found for extracting from kelp, on a commercial scale and at a good profit, the potassium and incidentally the iodine which it contains. The mere fact that in certain sections of California the plants are running night and day, that old concerns are enlarging their facilities and new ones fast entering the field, clearly demonstrates at least this much.

The idea of the utilization of the valuable materials locked up in kelp did not have its inception with the war and the war-famine. Years ago, the pioneers of western settlements learned from the natives of Alaska and our own Pacific coast how to fertilize their gardens with kelp from the sea. How these primitive agriculturists discovered that the seaweed is a fertilizing agent we cannot say. Their methods, though crude and uneconomical, were productive of results in their simple farming. They merely dragged the drift weed up from the beach and left it to rot on the spot it was desired to enrich. Western truck gardeners have at times adopted this method of fertilization.

Government experts who have looked into the matter with care, traveling on specially chartered boats from southernmost California waters well into Alaska, have made it clear that not all species of kelp are available for profitable potash recovery. The varieties best adapted to the work are those known as *nereocystis* and *macrocystis*. Beds of these aggregating 400 square miles in area have been located off the Pacific coast. This means something like 60,000,000 tons of raw material which, according to the government report, would work down into no more than 2,500,000 tons of potassium chloride. Kelp is 90 per cent water; and of the solid residue, it appears from these figures that something less than half is of value to the seeker for potash.

So far as known there is no kelp-working project under way on our eastern coast, although anyone who has ever spent a summer on the "outside" shore of Cape Cod will easily believe that there is no less seaweed in the Atlantic than in the Pacific. But for some reason the Atlantic species are not so well adapted to harvesting and conversion on a profitable scale. It may be said, however, that investigation here has not been nearly so extensive as in the west, and that in due time profitable fields may be located somewhere along the Atlantic or Gulf coasts.

The stalk of the kelp plant has the
(Concluded on page 226)

The Autoped—A Compromise Between Skates and Motorcycle

OF late there has appeared on the streets of American cities a queer little vehicle which is neither a motorcycle nor motor skates. In anything, it is perhaps a compromise between skates and the motorcycle, and it would seem that the idea for this unique vehicle has been suggested by the "scooters" made by the youngsters from a soap-box, a few pieces of board, and a discarded pair of roller skates.

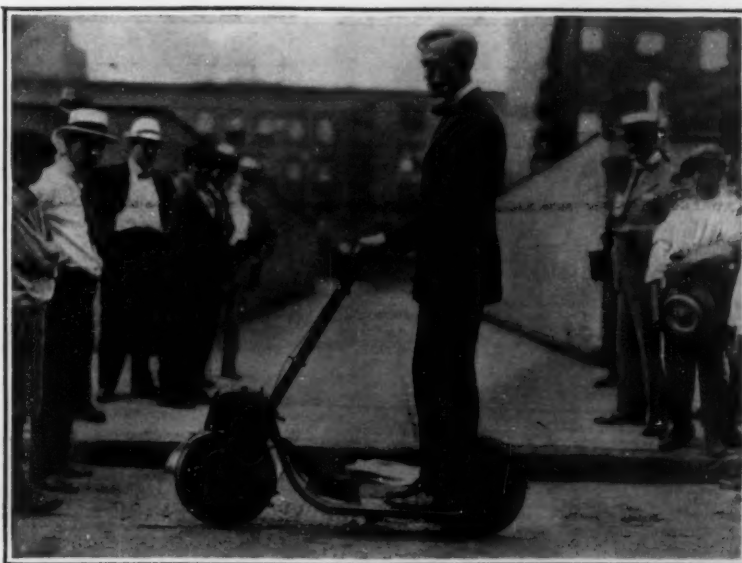
The new means of transportation is known as the autoped, and is propelled by a small, single-cylinder gasoline engine. It can attain a speed of 25 miles per hour on a level road. The control mechanism is centered in the handle, which is also used for steering. The autoped is distinctly up-to-date, for it is equipped with a self-starter for the engine.

Because of the small diameter of the wheels fitted to the autoped, it is obviously a vehicle for city streets and smooth highways. Its moderate first cost and low operating expenses should bring it within the reach of practically everyone.

A New American Aeroplane in which Exposed Wires are Entirely Eliminated

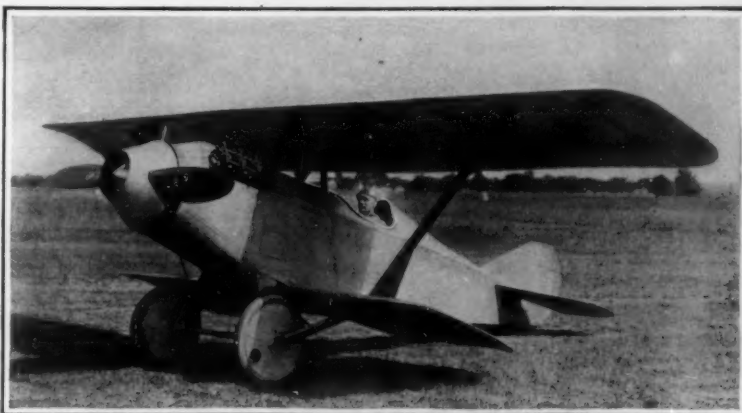
MUCH attention attaches itself at the present moment to the speedy scout machine that has been designed by Glenn H. Curtiss, and recently tried out at the Curtiss Aviation Field at Buffalo, N. Y. Piloted by Victor Carlstrom, the machine attained a speed of 119 miles per hour over a surveyed mile course, which is claimed to be the fastest yet made with a motor of 100 horsepower, therefore establishing a new world's record for such a power plant.

The new aeroplane has many refinements and several novel features, but the principal innovation is to be found in the elimination of exposed wires. Aeronautical constructors have long appreciated the detrimental effect of a mass of exposed guy wires on the speed of an aeroplane. In their efforts to eliminate guy wires they have substituted wooden posts, but the gain in speed has failed to meet expectations. Oval or "stream-line" wires have also been used in place of round wires, but still the speed of the machines has been greatly retarded by the network of wires. Hence the only ideal solution of the problem has been to eliminate the wires entirely without substituting a large number of wooden posts, which is precisely what Mr. Curtiss has done. His latest machine has only two posts, one on each side, and not a single wire is used in the trussing. The machine is a biplane with a 20-foot spread, and is equipped with a 100-horse-power, eight-cylinder engine driving a tractor screw.



The autoped, a gasoline-driven vehicle which is a compromise between motor skates and motorcycle

Some slight "cleaning-up" changes are planned in the design of the new machine, which will undoubtedly give it a speed of not less than 125 miles per hour. It is reported that the machine is handled excellently and is of remarkable stability. It is not purely a speed type, but has a sufficient supporting area to make it useful in general, fast military work, and because of its ample wing spread it possesses exceptional climbing



Aeroplane designed by Glenn H. Curtiss, in which exposed guy wires have been entirely eliminated

ability. The machine is said to be the first in which the head resistance as a whole has been reduced to such a great extent.

To those who have followed the progress of aviation it would appear that history is repeating itself. Several years ago the Nieuport machine established a new era in aeronautical construction—the streamline.

The Mystery of the Blue Gum and Malaria

By S. Leonard Bastin

DURING the later decades of the nineteenth century it was a common practice to plant Blue Gum or Eucalyptus trees in districts infected by malarial fever. It was held that the essential oil produced by the leaves combatted the harmful vapors rising from the swamps, laden with the poison of disease. The discovery that the malarial germ is introduced into the blood by a mosquito has settled once and for all the origin of the disease.

Yet it is only within the last few months that a somewhat mysterious point has been fully settled. The theory that the Eucalyptus trees neutralized the poison vapors is nonsense, yet the fact remains that where Blue Gums were freely planted, there was always a notable decline in the amount of malaria. For instance, in a certain district near Algiers the placing out of thousands of Eucalyptus trees completely transformed the conditions. Malarial fever of a peculiarly

virulent type had formerly been a constant feature, but, within 12 months of the planting of the Blue Gums the disease entirely disappeared, and is now unknown.

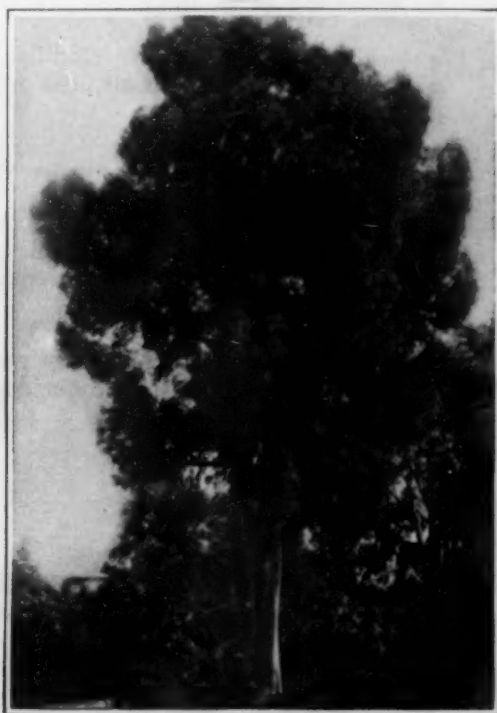
What is the explanation of this circumstance? It has been demonstrated that, of nearly all trees, the Eucalyptus absorbs the greatest amount of water. Two seedlings—a Blue Gum and a Plum—are shown in the accompanying illustrations. These were placed with their roots in water and the height of the water was carefully marked. The plants were kept in a warm atmosphere and examined at the end of 24 hours. The little Eucalyptus had disposed of four times the water that the Plum had been able to take up. Seeing that Blue Gums increase in height with great rapidity, often growing many inches a day in a hot position, the amount of moisture taken up increases on a greatly progressive scale. And this is just what brings about the downfall of the malarial mosquito. To complete its life cycle it is necessary that this insect should pass its larval stage in pools of water. With the coming of the Eucalypti these pools and indeed all marshy places disappear; the breeding spots of the mosquitos are gone and in time the insects vanish altogether. The district is

then free from malarial trouble simply because the carriers of the disease are not able to keep going.

The suggestion carried in the foregoing paragraphs might well be used in districts infested with malarial mosquitos, provided the climate is suited to the Blue Gums or Eucalyptus trees.



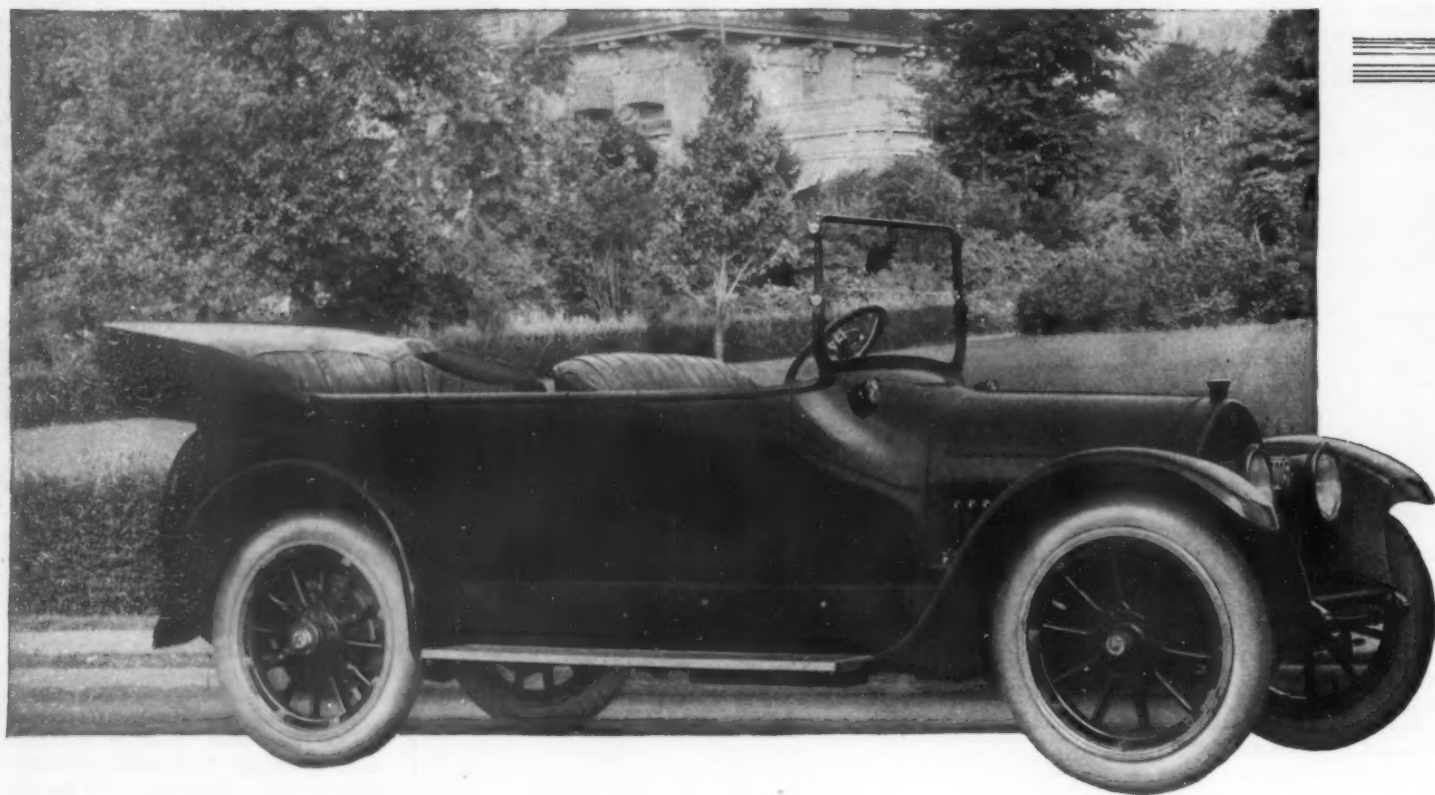
Blue Gum (left) and Plum (right) seedlings. White line marks water level



Eucalyptus tree thirty years old. (Note man at right.)



Twenty-four hours later. Blue Gum has absorbed several times as much water



The Coming of The



Specifications in Brief

ENGINE—Eight cylinder V-type, High-speed, High efficiency. **HORSE POWER**—S. A. E. rating 31.25; actual, more than 60. **COOLING**—Water. **RADIATOR**—Cadillac tubular and plate type. **IGNITION**, **STARTING**, **LIGHTING**—Cadillac-Delco, improved system. **LUBRICATION**—Automatic pressure feed. **CARBURETOR**—Cadillac. **CLUTCH**—Multiple disc, dry plate type. **TRANSMISSION**—Selective type sliding gear, three speeds forward and reverse. **AXLES**—Rear, Cadillac Timken, full floating; Timken bearings; Spiral type bevel driving gears. Front axle, drop forged, I beam. **DRIVE**—Tubular shaft. **BRAKES**—One internal and one external brake direct on wheels, 17 inch x 2½ inch drums. **STEERING GEAR**—Cadillac patented worm and worm gear sector type; 18-inch steering wheel, hinged to facilitate entrance. **FRAME**—Channel section. **WHEELS**—Wood, artillery type, Timken bearings, fitted with demountable rims for straight side tires. **TIRES**—36" x 4½". **WHEEL BASE**—125 and 132 inches. **TREAD**—56 inches. (Option 61 inches). **SPRINGS**—Front, semi-elliptic; rear, three-quarter platform. **CONTROL**—Center control. **GASOLINE SYSTEM**—Twenty gallon tank with gauge at rear. **STANDARD EQUIPMENT**—Cadillac "one-man" top; windshield; full lamp equipment; Gabriel Snubbers; Clock; Warner Autometer; Electric horn; Power tire pump; Foot rail; Robe rail; License tag holders; Tire carrier; tool box with locks; Set of tools; Tire repair kit; Handy lamp. Universal key fitting tool box, ignition and lighting switch and tire lock.

THERE is one thought in connection with the coming of this new Cadillac which we would like you to grasp at once.

With the advent of this car, the Cadillac "Eight" enters upon its third successive season, with no radical change in the basic principles of its design.

This is perhaps the first time such a thing has happened in motor car development, and you will quickly see its significance as applied to the Cadillac.

Quite properly, we believe, the World has always looked to the Cadillac Company for advanced ideas, improved practice and progressive principles.

The fact, therefore, that the Cadillac car has proven itself beyond the need of radical change, is, in itself, too impressive and too illuminating to call for comment.

It does not by any manner of means, imply that the Cadillac process of refinement had come to a conclusion.

In a multitude of ways, this is a better, finer Cadillac than any which has preceded it—the subject of unremitting research and scientific betterment in scores of details.

What the absence of radical change really means, is that the underlying principles of Cadillac V-type eight-cylinder construction have been proven fundamentally sound by the performance of 31,000 cars.



CADILLAC MOTOR CAR CO.



New Cadillac

It means that the Cadillac Company, with resources at its command probably superior to those possessed by any other motor car plant in the world, has arrived at the deliberate judgment that the *kind* of a motor car which it is now building, represents a higher degree of efficiency than any other in existence.

It means that this is the joint judgment of every expert mind associated with this Company. It expresses the judgment of 31,000 owners who cannot conceive of any respect in which Cadillac principles could be changed to their advantage.

The new Cadillac conforms to the finest Cadillac traditions, down to the least and last of details—and it advances them still more closely toward perfection.

It is a beautiful car to look upon.

The superior riding qualities, with which you are familiar, are enhanced and intensified.

The driving ease of last year and the year before, accentuated by the longer wheel base of the new car, is more marked than ever.

It is doubtful if motoring can give rise to a situation which can successfully challenge Cadillac powers.

The old feeling that it is folly to seek further—the old sense of security that the Cadillac represents the uttermost in a motor car—will come over you more strongly than ever.

We are serenely confident of the exhilaration and enthusiasm which you will experience on the occasion of your first ride in this unusual car.



Body Styles and Prices

The Type-55 Cadillac will be available with a complete variety of body styles, as follows:—

Open cars, 125 inch wheelbase; Seven Passenger with disappearing auxiliary seats \$2080. Four Passenger Phaeton \$2080. Two Passenger Roadster with two passenger disappearing rumble seat \$2080. Four Passenger Close Coupled Roadster \$2080.

Convertible styles, 125 inch wheelbase; Seven Passenger with Cadillac body (Springfield type) \$2675. Four Passenger Victoria (convertible) \$2550.

Enclosed cars, 125 inch wheelbase; Four Passenger Coupe \$2800. Five Passenger Brougham \$2950.

Enclosed cars, 132 inch wheelbase; Seven Passenger Limousine \$3600. Seven Passenger Landaulet \$3750. Seven Passenger Imperial \$3750. Prices include standard equipment, F. O. B. Detroit. Prices are subject to advance without notice.

DETROIT - MICHIGAN



Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Tackle for Deep Sea Fishing

SALT water fishermen will be interested in an ingenious rigging that has been devised by Dr. George W. Weld, of New York. The fundamental point is the flat sinker with square edges, of about 12 ounces, which is coupled to the line by a swivel through which the line can run freely. The line is attached to a short length of wire that carries a light disk of metal about an inch in diameter, termed a "tide pusher." To the other end of this wire any desired arrangement of hooks and leaders are attached by swivels. The operation of the outfit, as described by the designer, is as follows: When fishing from the shore with an out-going tide a cast of say 50 feet may be made, and the sinker, on account of its shape, will lie stationary on the bottom. The current, however, will take hold of the "tide pusher," and will carry the hooks far beyond, 500 to 1,000 feet, to the deep holes outside the surf where the big fish lie, which could be reached in no other way. Another feature of the pusher is that it acts as a drag after the fish has been hooked, and this is an advantage in case of the larger varieties of fish, and those that take the hook with a rush. The sketches clearly illustrate the idea.

Tire-Mile Cost Found Rapidly by Novel Chart

DESIGNED to enable automobile users to calculate the cost per mile of their tires without the necessity of any mathematical calculations, the accompanying chart just issued by one of the large tire companies enables this to be done in a few seconds. The chart consists of three vertical scales, the one at the left representing the original cost of the tire, that at the right the mileage covered and that in the center, the cost per mile traveled.

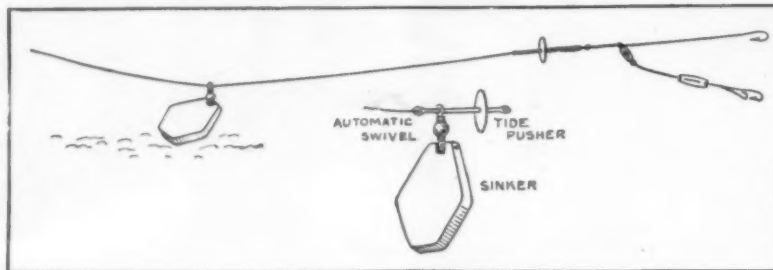
By placing a straightedge on the point of the left scale corresponding to the cost of the tire and the point of the right scale according to the mileage run, the cost per mile is read directly at the point where the line thus laid down crosses the center scale. For instance, if your tire cost \$75 and ran 7,000 miles, the line would be as shown at XX, giving the cost per mile run of 1.1 cents. Or if the tire cost \$9.50 and ran for 1,950 miles, the line would take the position of YY, showing a cost per mile of 0.48 cents.

A Hose Clamp with an Unshakable and Non-leakable Grip

A HOSE clamp recently perfected by Charles Elkin of New York appears to have solved in a simple yet effective manner the problem of securely attaching rubber hose to faucets or other pipe fittings.

The accompanying illustration, showing the three stages in attaching a rubber hose to the new clamp, tell their own story. It will be noticed that the hose clamp consists of a main member, which is provided with three hinged arms, and a sliding sleeve which can be moved down over the arms. In operation, the hose is first pushed onto the nozzle, which has ridges securely to hold the hose in place in conjunction with the arms which are turned down on it. The next step is to turn the cap so that it will screw in place over the arms, holding them firmly in place. Since the rubber hose is held in a vise-like grip between the nozzle and the arms, it cannot be pulled off without tearing the rubber, which obviously requires much force and far more than that ever encountered in regular service. It is well to add that a spiral groove cut inside the cap or sleeve engages with a guide pin on the clamping arm frame, so that the cap must go up or down according to the direction in which it is turned.

Recently, one of the new hose clamps of a size taking $\frac{3}{8}$ inch inside diameter tubing was submitted to hydrostatic tests which convincingly demonstrate the holding power of the device. One clamp was secured to each end of tubing and, with one end plugged, hydrostatic pressure was applied to the other end. Ordinary (cloth inserted) tubing held pressure of 300 pounds to the square inch for five minutes. Pressure was



A "tide pusher" to carry the hooks beyond the surf

then raised gradually, when the tubing burst at 500 pounds at a point far remote from the clamps. The test was repeated several times and each time the tubing burst before any signs of leakage or slipping

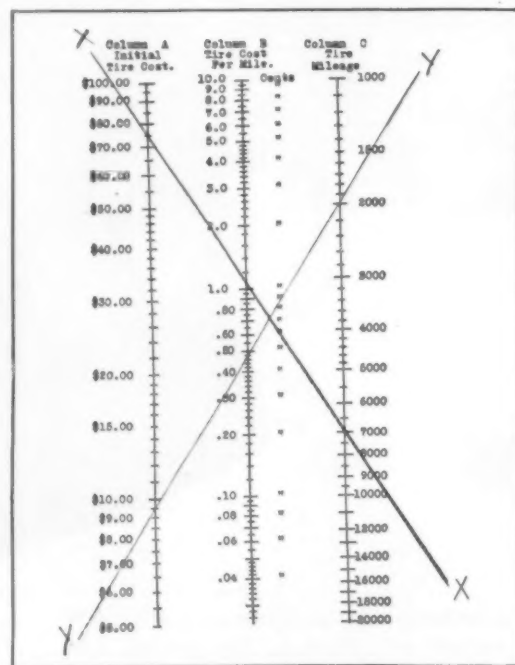
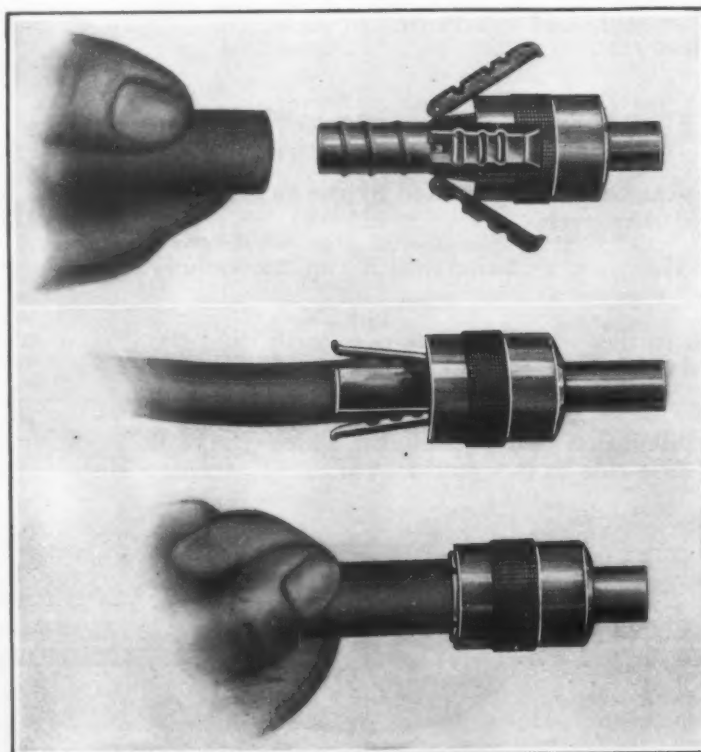


Chart for rapid determination of tire cost per mile

were noted at the newly-invented hose clamps. The new clamp is made in a variety of different sizes and styles, for use wherever a hose clamp is necessary or desirable. It is comparatively inexpensive.



Three stages in fastening a rubber hose to a pipe system, using the newly-invented clamp

An Electro-Magnetic Clock that Runs Two Years Without Attention

THERE has lately appeared a timekeeper of an entirely new type, utilizing electricity and magnetism in its operation. The designer of the clock, H. E. Warren of Ashland, Mass., claims that its mechanism is absolutely noiseless in operation and that the timekeeper is exceptionally accurate. It is said to embody improvements in the mechanism and especially the escapement, which are more radical than any other made during the previous century.

The various components of the new time piece are clearly shown in the two illustrations on page 219. From the base of the clock, B, there arises a column A which forms a support for the pendulum and also serves as the container for the battery G. The pendulum consists of a permanent magnet C riveted firmly to a rod D of a special metal that is practically unaffected by changes in temperature. Mounted upon the column and located within the gap or opening of the magnet C is a coil of extremely fine insulated wire E, the ends of which are soldered to two brass rods at the back of the column. One of the brass rods is shown at F. Within the column there is room for a special battery G of the same diameter but somewhat longer than the cells that are commonly used in flashlights. This battery rests upon a strong spring and is held down by the pointed end of the brass rod W, which may be swung away from the battery in order to replace it.

Mounted upon the pendulum rod is a brass case H, within which is located what the designer chooses to call an electric pulsator, but which is in reality a form of switch that is actuated by the swing of the pendulum. The pulsator consists of a sealed glass tube from which the air has been exhausted. Inside the glass tube, in an inner steel tube, protected from all atmospheric influences such as dust, moisture, or oxidation, is a device which sends electric impulses through the electromagnet E at every complete swing of the pendulum. These impulses are of such a nature as to maintain the swing of the pendulum in practically the same width of arc whether the battery be new or old. If the swing of the pendulum be increased or decreased by external means, the electric pulsator will quickly restore it to its normal value. Thus we have the basis of a timekeeper, consisting of a pendulum swinging over a uniform arc and consequently at a uniform rate.

In the case of the thousand-day model of the new clock the method of supplying power to the pendulum results in an extremely high efficiency. With the usual method of driving electric clocks, such a battery as is here provided would last from three to possibly six months; but with the new electromagnetic clock the battery will last two years in service.

The next step in the development of the clock is to transmit motion from the electrically-driven pendulum to the movement. This is accomplished as follows: A case K, which is practically air-tight, is screwed to the back of a heavy brass plate carrying the movement. Within the case K, mounted in sapphire jewels so as to revolve with the utmost freedom is a vertical shaft L made of hardened magnet steel. Upon this shaft is cut a coarse screw thread M, with which meshes a gear mounted upon a horizontal pivot. The lower end of the shaft L carries a curved extension projecting downward into a cup or depression at the bottom of the case K. This cup is nearly filled with a fine quality of light mineral oil. Neither air nor dust can enter the case K and the oil which it contains cannot escape. Mounted upon the pendulum rod D is a little platform or bracket N, and concealed upon the platform N are two small horseshoe permanent magnets. The poles of the magnets on N strongly attract the curved extension of the lower end of the shaft L, across two thicknesses of metal and an air space.

According to a new principle broadly patented in the United States and foreign countries, the reciprocating or swinging motion of the pendulum which moves the bracket N to and fro across the axis of the magnetic shaft L, causes the latter to revolve

once for every complete swing of the pendulum. The action is extremely simple, but the explanation is rather complicated and will be omitted here.

It will be observed that by the means just mentioned the oscillating motion of the pendulum has been converted into a continuous motion of rotation of the shaft *L*; and the shaft, by means of the screw thread *M*, transmits motion at a greatly reduced rate to the first gear of the clock train. The remainder of the clock train is more or less conventional, although the bearings are so designed as to run without lubrication. The entire works of the clock are protected by a dust-proof cover *I*.

In order to make the clock complete, means must be provided to regulate the rate of the pendulum. In other clocks this is accomplished by moving the pendulum bob up or down on the rod or by changing the point of flexure of the pendulum rod suspension. In this clock a much simpler and, it is claimed, more accurate means of accomplishing the same result is used. This consists of a small permanent magnet *O* mounted beneath the hollow base of the clock so as to be moved against the resistance of the spring *P* by means of an adjusting screw *Q*. A perfectly definite force of attraction will be maintained between the end of the regulating magnet *O* and the bottom of the pendulum magnet *C*, but the amount of this force of attraction can be varied by adjusting the screw *Q*; the force will diminish as the magnet *O* is moved farther away from *C* and vice versa. It is a fact that the rate of the pendulum, that is, the number of swings per minute, will depend upon the force of attraction between *O* and *C*, and consequently the rate of the clock can be easily adjusted by means of the screw *Q*. A very important advantage of this method of regulating is that the clock need not be stopped nor the pendulum disturbed in any way for regulation. The accuracy of the results obtained is such that a clock can be regulated without difficulty to run within one minute per month.

For the purpose of setting up the clock correctly on a mantel or other surface, three leveling screws *R* are provided beneath the base, and a pointer *S* and indicator *T* are on the column and pendulum rod, respectively.

Elevator for Ashes

THE hard work of loading ashes into a dump cart has been eliminated by an elevator that extends from the basement of a building, where the furnace is located, to a point about 8 feet above the level of the sidewalk. It is so designed that when not in use the elevator sinks flush with the pavement and is covered by a lid, the device being raised and lowered by a gear that engages cogs on both sides of the metal shaft. The interior of the shaft contains a series of buckets that convey the ashes to a chute about 2 feet above the level of the wagon, so that the driver has nothing to do except level the load as it is deposited in the body. The elevator is located about a foot from the curb so that it is convenient for a wagon to drive up alongside of it, and the operation of emptying a large bin of ashes into the vehicle is the work of a few minutes. One man in the cellar shovels the ashes into the elevator, and the man in the wagon spreads them.

The old method for loading ashes has been to hoist the cans to the sidewalk, and then empty them into the cart by man-power. This elevator replaces the several operations of that method by a single one, and eliminates much noise and flying dust.

A Humane Rat Trap

THE Los Angeles Athletic Club possesses a rat trap that reminds one of the mystic maze that adds to the delight of visitors at a county fair or amusement resort.

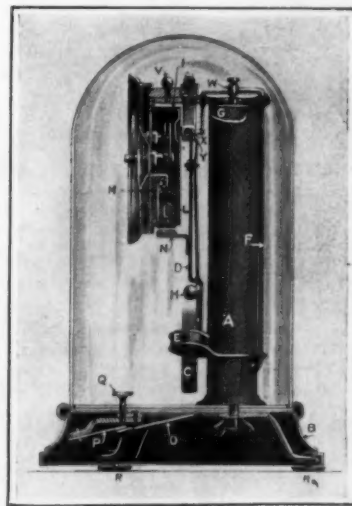
The principle of the invention is this: Entrances are placed at every corner and part of a building that a rat would be likely to visit; for example, in the kitchen, butcher shop, pantry, and store room. These entrances are baited to coax the rat inside. When the rat comes far enough into the hole, he steps on an automatic trap door which drops from under him, letting him gently down into a wire tunnel or passage. The door automatically closes over his head, leaving only one way open to travel, and that is straight ahead. In a large building this tunnel slopes gradually down. The rat is naturally led by the incline to the next door and slips through to the lower tunnel



Loading an ash cart with an elevator

on the story below. The device works somewhat like the blood vessels in the human body, in which little valves compel the blood to flow only in one direction.

The rat is not injured by slipping through the doors, and soon becomes used to it. After trotting by easy stages, perhaps several hundred feet, the rodent winds up his tour in the engine room. Here it is warm and comfortable. As the rat passes the last door, a strange click is heard, and a gate and trap door slam. The



Front and side views of an electromagnetic clock of novel design

queer little click means that Mr. Rat has been counted by an automatic register. He now enters the death chamber, a sheet-iron, tank-like affair, containing food and water for the victims.

When the tank contains a dozen or more rats, the operator closes the air vents and turns on the gas. The rodents are thus surely but humanely executed.

This trap is probably the only one in existence that not only does not scare the rats, but attracts them

because it has the appearance of a safe hiding-place. The trap is excellent for use in hotels, office buildings, apartment houses, big ships, cafes, restaurants, or in fact any buildings larger than a residence.

This trap was recommended by Dr. Rupert Blue, Naval Health Surgeon, and in the first few months of its operation at the Los Angeles Athletic Club, it caught, registered, and executed more than 4,500 rats.

The Current Supplement

AN article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2122, for September 2nd that will be of value and interest to many classes of scientists is *The Extension of the Spectrum Beyond the Schumann Region*, which describes the methods and apparatus employed, and the difficulties encountered. Another article of special interest to the astronomer is *Monochromatic Photography of Jupiter and Saturn* describing experiments with various ray-filters and results attained. It is accompanied by a number of photographic illustrations. *Bridge Building in New Zealand* describes and illustrates several structures recently erected, two of which lay claim to considerable originality and have the merit of being very economical to build. There are a number of excellent photographs accompanying the article that make the methods of construction clear. *Spinning and Weaving in Early Times* gives a very readable account of primitive methods, some of which are still in use. *Fluxes for Oxy-Acetylene Welding* describes methods employed for welding various metals in a process of great value in the mechanical arts. *The Giant Salamander of Japan* gives a short account of an amphibian of which little is known in this country. *Goldsmith's Work in the Dark Ages* is an interesting account of an ancient handicraft, the beautiful products of which serve as models for modern designers. *The Photogenic Substance of the Firefly* discusses the problem of how the insect produces light. A number of other articles of value are also included in this issue.

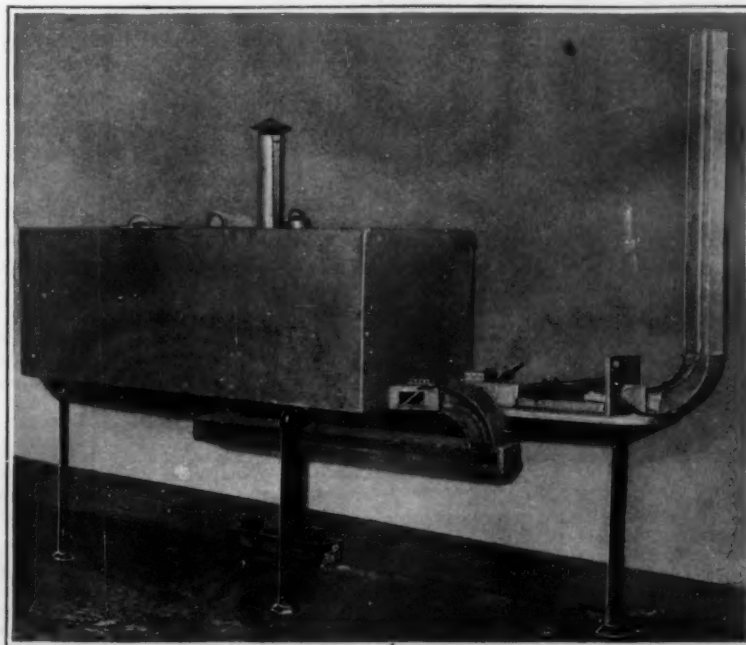
A New Vegetable Dye

VIJAO is the local name of a plant which, according to a recent Commerce Report of the Bureau of Foreign and Domestic Commerce, the natives of Porto Rico are using as a source of dye. It is claimed that an ink of exceptional fastness is made from the seeds of this plant, which has been identified botanically as *Renealmia craltata*. It is a member of the ginger family (*Zingiberaceae*), which includes a long list of valuable food and drug plants. Ginger, turmeric and cardamon are among the drugs that are produced by this important group of plants.

Vijao is as yet but little known in most parts of the West Indies. In general appearance and manner of growth the plant is not unlike that of cultivated ginger, the chief difference lying in the arrangement of the flowers. In the case of vijao these are arranged in a panicle, while those of the ginger plant are more or less in the form of a cone-shaped spike.

It appears from various well-authenticated reports that this plant and some very closely related forms are distributed over a very extensive territory. Vijao grows on a number of the West Indian Islands and is found also in the Guianas and in Brazil. The Brazilians call this plant "papatinga," which has relation to its tinctorial properties. In some parts of Brazil it is popularly known as pacova, and the seeds, which are called "fructos de pacova," are said to be collected for the purpose of making a bright red dye of common local use.

While the principal value of this plant is for its seeds in making dye, it is worthy of notice also because of its use as an article of food and as a drug. Vijao is an herb with a creeping rhizome or underground rootstock similar to that of the ginger plant, and in some parts of the West Indies these rhizomes are collected from the wild plants and used for the same purposes as the true ginger. Both the seeds and rhizomes are employed medicinally as an aromatic tonic. The seeds serve also as an anthelmintic. The leaves are used locally as a cure for a number of ordinary ailments. It will thus be observed that every part of the plant is of some use, and the collection of this wild growth should be encouraged.



A rat trap that disposes of mice in a humane way

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Old Man Curry is racing his string of prophet-named horses again. In "The Modern Judgment of Solomon", Charles E. Van Loan tells another of the old man's amusing experiences. Read it in the September 9th issue of

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RECENTLY PATENTED INVENTIONS

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Pertaining to Apparel

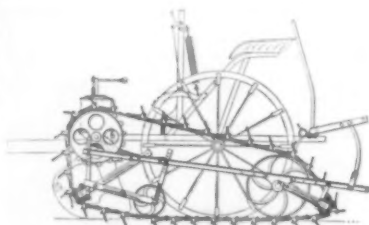
SHOE ATTACHMENT.—A. L. LUSSIER, P. O. Box 622, Springfield, Mass. This invention relates to an attachment for laced shoes and other laced articles, to afford means for receiving and securely holding the lace at each end of the opening in the shoe or other article, and of a character to permit of the instant and simultaneous release of the lace from the several lace-receiving holes.

Electrical Devices

ELECTRIC DISPLAY DEVICE.—C. TREGONING, care of Hotel Wallack, 43rd St. and Broadway, New York, N. Y. In this case the invention refers to display devices and particularly to an electric display device wherein an illusion is produced by rotating in different ways lighted lamps so as to give the appearance of greatly agitating and shaking the lamps.

Of Interest to Farmers

CORN PLANTER.—J. T. McCLAIN, Greentown, Ind. This invention relates more especially to check row planters, and provides means for controlling and actuating the seed dropping mechanisms thereof, without the ne-

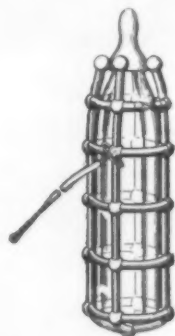


CORN PLANTER

cessity for wire attachments, markers, or other cumbersome devices for this purpose now in use. It provides means for measuring and marking off the land and spacing and aligning the seed hills, irrespective of the shape or lay of the land to be planted, without necessitating alighting of the operator from the planter in the course of the work.

Of General Interest

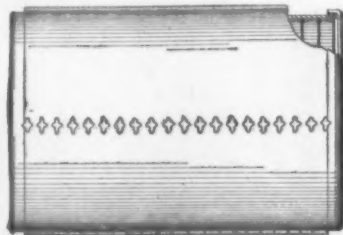
BOTTLE PROTECTOR.—J. E. COSGRIFF, 201 W. 109th St., New York, N. Y. This invention relates particularly to a means for pro-



BOTTLE PROTECTOR

tecting a child's nursing bottle. It provides a cage-like protector to prevent breakage of the bottle due to impinging against the floor, crib, chair, or other device. It provides a convenient means for attaching the bottle to a flexible strap or the like, whereby it is impossible for a child to throw the bottle beyond its reach. The device may be made in any substantial manner, and sold at a low cost, and thorough sterilization of the parts is easily accomplished.

COIN HOLDER.—H. G. KITTELL, Mountpleasant, Tenn. This coin holder is for use



COIN HOLDER.

In handling coins in banking houses and other financial institutions. It may be quickly opened and closed, and when opened may be disposed upon a table or countertop to be in position for the ready reception of coins. The holder is in the nature of a pair of semi-tubular body sections hingedly connected together along one longitudinal edge and being each provided at its ends with a semi-circular closure or end wall, the body sections having means whereby they may be readily detachably connected together.

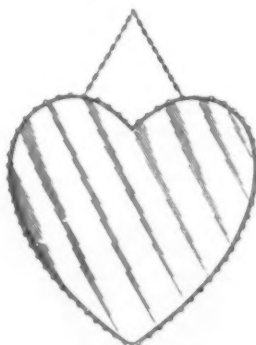
EXPOSURE ATTACHMENT FOR CAMERAS.—R. TROXELL, 1006 Pine St., San Francisco, Cal. One of the principal objects of this invention is the provision of an improved ap-



EXPOSURE ATTACHMENT FOR CAMERAS

paratus whereby the shutter of the camera may be conveniently manipulated from a distance, in order that the operator may himself appear in the picture.

PICTURE FRAME.—J. G. ROBERTS, Holly Springs, Miss. This invention provides a frame constructed of a member which may be glass



PICTURE FRAME.

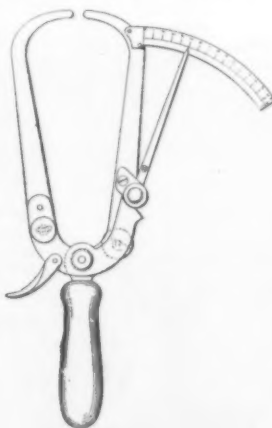
and heart shaped, around which there is disposed a ladder chain, the links of which engage both sides of the member at the member's edge, the ladder chain being held in place in the recess at the top of the heart by a wire which is secured to the chain at the bottom of the heart.

TWIN CONNECTION FOR FIRE HYDRANTS.—W. H. B. HALAHAN, 35 Purchase St., Rye, N. Y. The improvement relates to the hose connection between a hydrant and a fire engine, and provides a new and improved twin connection arranged to supply practically double the amount of water from an ordinary hydrant to the pumps of the fire engine.

Hardware and Tools

PIPE CLAMP.—M. M. MIDDAGH, 208 North Amelia Ave., Tampa, Fla. An object of this invention is the provision of a clamp, the size of which can be varied and the pressure of which on the object it clamps can be evenly adjusted, as the taking-up on the clamp can be made within predetermined points of the circumference of the clamp.

CALIPERS.—L. KAPLAN, care of Stepanek & Kaplan, 506 E. 19th St., New York, N. Y. Among the principal objects which the present invention has in view are: to provide a scale for recording the space separating the ends of the caliper arms; to provide simple and effi-



CALIPERS

cient means for magnifying the reading of the scale; to provide means for facilitating the operation of the calipers; and to provide means for setting the calipers for an established measurement.

WINDOW LOCK.—C. W. STEIN, 2316 N. Clark St., Chicago, Ill. This inventor provides a novel form of lock to be attached either to a window frame or one of the sashes, whereby, in the first instance, the lower sash may be locked in closing position and whereby, in the second instance, the upper sash may be lowered and opened, to permit of proper ventilation and then locked against further opening.

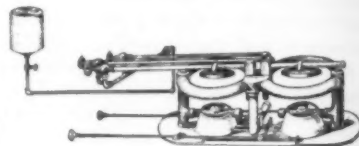
BEARD SOFTENER.—T. G. MORGAN, Morgan Sales Co., Inc., Shamokin, Pa. The invention provides means whereby a rubber brush may be readily associated and permanently held in connection with a supporting cap, and in connection with a handle for the manipulation of the complete implement, and in such manner that the handle may be secured in connection with the cap by the same means employed for holding the brush.

PIPE REAMER.—D. H. HOREA and F. G. SCHULKE, Portage, Wis. This invention relates to reaming devices for pipes, and has for an object the provision of an improved construction and arrangement adapted to be applied to a die stock so as to ream the pipe simultaneously with the cutting of the thread.

WRENCH ATTACHMENT.—D. J. PUGH, 437 Washington St., Pottsville, Pa. The invention has particular reference to an attachment for rendering the tool convertible to different uses. It provides a removable jaw adapted for connection with an ordinary nut wrench whereby the same may be readily and quickly converted into a pipe wrench.

Heating and Lighting

LIQUID FUEL BURNER.—F. W. EVELAND, Hot Springs, Ark. This invention relates to burners which utilize liquid fuel as the heating medium and which liquid fuel is volatilized or converted into gas by passage through a retort in a heated state prior to ignition. It



LIQUID FUEL BURNER

provides a construction wherein substantially complete combustion will take place to the end, but a very inappreciable carbon or soot deposit will take place in the retort and burner, avoiding the necessity of frequent cleaning of the parts.

SCREEN FOR HEADLIGHTS.—E. B. PHIPPS, 555 E. 9th South St., Salt Lake City, Utah. This invention relates to improvements in screens for headlights, especially those of automobiles, street cars, and the like. It provides a device which may be attached to any



SCREEN FOR HEADLIGHTS

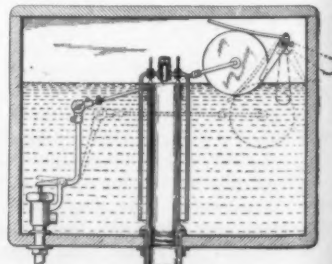
ordinary headlight with very little trouble, and which, when so attached, will eliminate the glare which is so apt to cause accidents by blinding the person upon whom the light falls. It provides a screen which may be adjusted to headlights of various sizes.

PORTABLE FURNACE.—A. E. BROWN, 407-408 Mills Building, El Paso, Texas. This invention is an improvement in that class of portable furnaces which are constructed of sheet metal and adapted for supporting and heating metal wash tubs or boilers, also camp stoves or ovens and sad irons, etc. It is for use with coal or wood for fuel, and can also be used with oil or gasoline burners.

BURNER.—F. W. EVELAND, Hot Springs, Ark. The inventor provides an oil burner so constructed that the retort will be automatically cleaned during its operation. He provides means whereby any residue collected in the burner when heating up and cooling off is automatically eliminated therefrom. The burner tip provided is self-cleaning.

Household Utilities

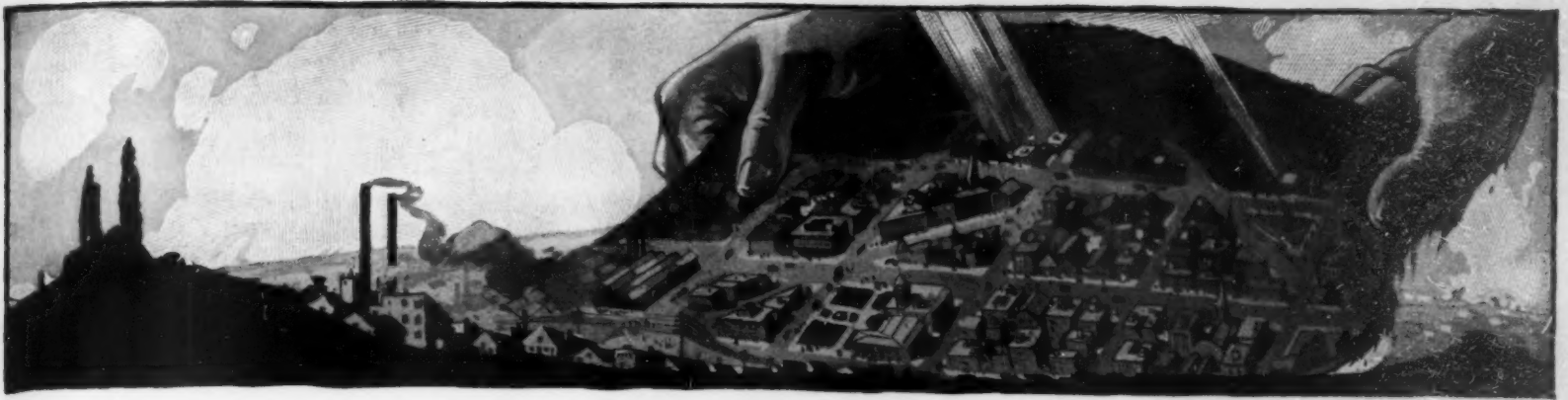
FLUSH TANK SIPHON.—J. S. KATZIN, 45 South Orange St., Newark, N. J. Among the objects of this invention is to provide a flushing device for toilet tanks or the like adapted



FLUSH TANK SIPHON.

to be readily fitted to either high or low down tanks and applicable also to tanks now in use without the necessity for disconnecting the tank from the outlet pipe.

(Continued on page 222)



IF you tipped up a town and looked at its roofs, you'd see here and there cosy houses protected from fire, and kept dry and weather-tight in spite of time and the elements by soft tinted shingles of a remarkable material. The factory yonder and the tall office building that graces downtown are topped with roofs that are basically of the same material. The barn at the edge of town is roofed from ridge pole to eaves with it in another form. Here a garage, there a marble bank, a church, a school, a steel mill — all standing under

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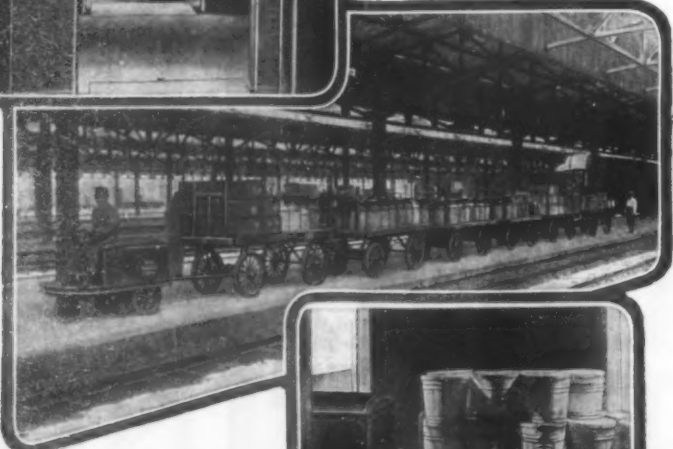




In Kansas City, Mo., Edison-equipped tractor operating night and day, except for short intermittent charging periods.



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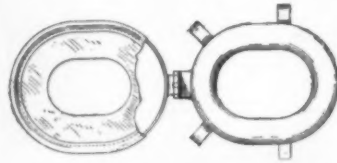
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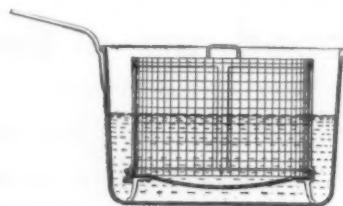
SANITARY CLOSET SEAT.—L. ROMINE, 1118 I St., care of St. Regis Hotel, Fresno, Cal. This invention is an improvement in sanitary closet seats, and has for its object to provide a seat wherein a supporting ring is



SANITARY CLOSET SEAT

provided of arched form for supporting a series of superposed sheets of toilet paper, which are adapted to be removed after use, and wherein a protecting cover is provided for protecting the sheets when not in use.

COOKING UTENSIL.—MARY C. BROWN, Annex Hotel, Fargo, N. D. This invention re-



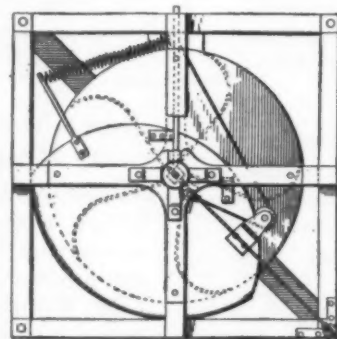
COOKING UTENSIL

lates to the double boiler type of utensils, and provides the inner member of such form as to be readily removed from the outer member without danger of scalding the hands, wherein the material cooked cannot be burned, and from which the cooked material may be removed to a suitable receptacle, such as a plate or platter, without the necessity for inverting the said inner member, and also wherefrom the water may be drained without distributing the material contained in the utensil.

Machines and Mechanical Devices

SEWING MACHINE.—E. I. MONES and W. E. KELLAR, Luling, Tex. This invention has to deal more particularly with a sewing machine having an embroidering or darning spring presser foot attachment. Heretofore these attachments have been applied to ordinary sewing machines, in which the needle bar reciprocates at too high a speed for enabling embroidering or darning to be satisfactorily accomplished. This objection is overcome in the present invention.

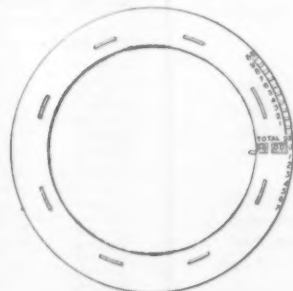
WINDMILL.—G. W. TARR, 90 Haight St., San Francisco, Cal. In this case the invention



WINDMILL

is an improvement in wind mills, and has for its object the provision of a mill of this character, wherein simple and easily operated mechanism is provided in connection with the mill for permitting the speed of the mill and the power exerted by the mill to be varied in accordance with conditions.

ADDING MACHINE.—J. H. MASON, Address A. W. Lawrence, Times Building, New York, N. Y. This invention relates to adding machines, and has more particular reference to the kind in which two toothed counting rings are rotatably and concentrically mounted in a



ADDING MACHINE

casing, one of the said rings being adapted to be rotated by a pencil or stylus engaging with the teeth on the ring, while the other ring is automatically moved or rotated to the extent of one tooth for every complete revolution of the counting ring which is rotated by the pencil.

Railways and Their Accessories

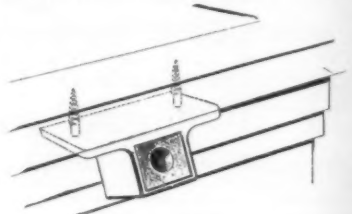
RAILWAY SWITCH.—R. S. BETTS, and P. H. HAMILTON, 274 West Iowa Ave., Memphis, Tenn. This invention has reference to an improvement in so-called split switches as distinguished from stub switches, the object of the invention being to prevent the flanges of car or locomotive wheels from striking and thus wearing and blunting the switch point.

BLOCK SIGNAL SYSTEM.—W. V. RYDEN, 175 Newbury St., Boston, Mass. The more particular purpose in this case is to maintain signal lamps in condition to show danger when a block is occupied and at no other time, the signalling to be as nearly as practicable independent of the number of trains which may occupy the block, and controllable by the direction in which these trains are traveling.

STAYBOLT.—P. DIMAGGIO, 23 Trinity Place, Albany, N. Y. This invention relates to flexible staybolts for connecting the inner and outer sheets of steam boilers. An object thereof is to provide a simple, strong and inexpensive bolt adapted to be used in boilers having straight or curved surfaces and subjected to high pressure of steam.

Pertaining to Recreation

CHALK HOLDER.—C. L. MOORE, 9606 51st Ave., South Seattle, Wash. This holder is of the character used for holding blocks of chalk for billiard cues and the like, wherein a holder is provided for receiving the chalk, and having means for securing the chalk in place in

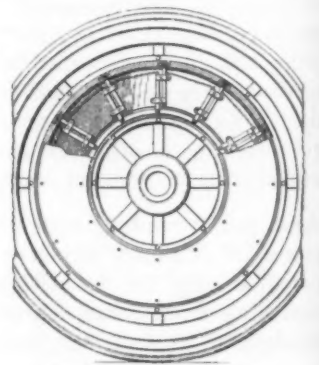


CHALK HOLDER

the holder, and means for permitting the holder to be secured to a billiard or pool table in such manner that while one face of the chalk will be exposed to permit the chalking of the cue, the holder and the chalk will be held in a position such that it will not interfere with the use of the table.

Pertaining to Vehicles

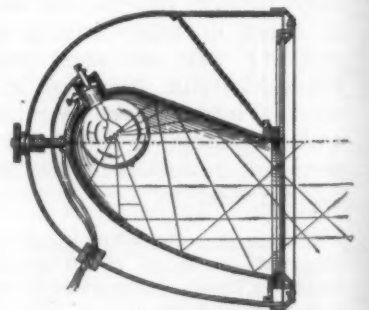
RESILIENT VEHICLE WHEEL.—A. FREUND, Box 1435, St. Louis, Mo. In this invention the object is to provide a new and improved resilient vehicle wheel of the solid



RESILIENT VEHICLE WHEEL

tread type, which is very simple and durable in construction and arranged to permit of readily assembling and disassembling the parts and to provide the desired resiliency without danger of punctures or blow-outs.

AUTOMOBILE LAMP.—A. G. SMITH, 37 Railroad Ave., Freeport, Long Island, N. Y. This invention provides a construction of headlight whereby the glare therefrom may



AUTOMOBILE LAMP

be reliably controlled without minimizing the effectiveness of the light for driving purposes. It provides a reflecting structure adapted to concentrate the light upon the roadway downwardly and forwardly in front of the vehicle, but adapted to prevent all glare from the lamp, especially from its upper portion, that would tend to be objectionable to parties approaching the vehicle carrying the lamp.

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WANTED—A RESOURCEFUL mechanical designer to improve and simplify the construction of a motor driven agricultural implement. Three months' work. Salary and contingent fee. Answer by mail only. Theo. H. Price, 15 Wall St., New York.

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A MACHINE OR DEVICE to manufacture: patented articles considered on a royalty basis or will finance if terms are mutually satisfactory. Write L. R. S., 48 Loring Ave., Salem, Mass., U. S. A.

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Blazing a Trail for the Industries

(Continued from page 206)

Industrialists all over the country have brought their problems to the institute. From mines in the west have come requests to improve processes of refining metals; in the east various manufacturers have sought better ways to make candy, textiles, and a variety of other things. Southerners have asked how to extract and preserve the juice of the citrus fruits. Millers in the northwest have called for practical methods of utilizing waste products of the manufacture of flour. Such diverse subjects as the technology of soap and soap fats, the corrosion of steel, the bleaching of oils, the development of steam power accessories and pharmaceutical preparations, the solution of hydro-metalurgical problems, give an idea of the scope of the institute's work.

One of the first problems presented the institute, and one still under investigation, was the improvement of laundry processes. Chemically speaking, this is a pretty large contract. An expert chemist receives \$1,800 per year for washing small samples of various materials in all the different compounds that his ingenuity suggests. He is seeking cleansers that will not injure the clothes, as well as better and cheaper ones, which will eventually mean lower laundry bills. To a certain extent he is also standardizing methods of washing for all laundries. Already he has found a perfect sterilizing agent.

It would be difficult to find a subject of investigation of greater interest to the nation at large than this, unless perhaps it were that of the three fellows who knead and bake bread all day, and cut open the newly baked loaves to count and measure the holes left by the yeast. They aim to reduce both number and size of these, thus producing a bread of firm even texture throughout. Already they have discovered how to make better bread with half as much yeast, saving \$300,000 per year for one bakery alone. This sum would pay their salaries for a good many more years than one. These men, incidentally, have rediscovered the secret of the salt-rising bread of our grandmothers.

Glass manufacture has come in for a considerable share of the attention of the institute fellows. Glass globes have been made of such elasticity that on being accidentally dropped they will not break. Three new glasses for specific purposes have been developed, and an improved process of making glass pots has been found which more than doubles their life and is valued at \$10,000 per year by the manufacturer. An increased production of 20 per cent in bottle glass has resulted from investigations in its composition, and the gas used in firing glass tanks has been changed for the better.

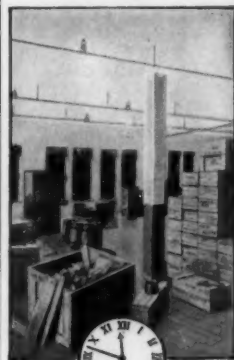
In the museum room at the Mellon, in which the discoveries of the members are on exhibition, are to be seen two test tubes filled with a bleached cotton seed oil that is as clear as water, and can therefore be used as base for any manner of oil. There is shown a composition flooring far more resilient than cement, warp-proof, crack-proof, and water-proof. Two years were spent by one chemist finding a new silicate cement for filling teeth that is superior to any other on the market. It has the appearance of porcelain and the durability of gold, while it is within the reach of every pocket-book.

Other problems on which the scientists are now engaged are equally interesting and important. One is searching for an acceptable butter substitute. He mixes various oils, fresh cream and pure butter, churns them in a miniature churn, and tests the mixture on his own palate. A manufacturer of collars and shirts has established a fellowship for the purpose of finding an ink that will not fade when used for stamping his trade-mark on his goods, and also a way to remove oil stains from shirts soiled during manufacture. He estimates that the chemist's success will save him \$30,000 annually. A large

(Concluded on page 224)

Snap! Spurt! Splash!

Here's a Grinnell in Action!



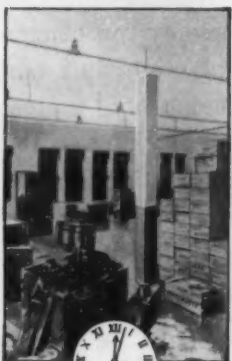
1. The Grinnell sprinkler heads on the pipes near the ceiling are on duty, like sentinels waiting for a fire—waiting perhaps for thirty years.



2. Here comes the fire at midnight. The column of heat rises and at 155° the fusible strut in the nearest Grinnell head softens and melts.



3. Snap—spurt—splash. A drenching downpour right on the heart of the fire. Alarm bell clanging in the distance.



4. Fire out before watchman arrives. Water turned off. No damage worth reporting. Next morning—business as usual.

And just as sure as water kills fire, a Grinnell System will extinguish or control a blaze before it gets half way started. Usually the fire is out before the watchman can get there in answer to the alarm. No wonder you can get insured for almost nothing if you have a Grinnell System overhead!

It Pays for Itself — "and Then Some"

Here is the way it figures out in the case of a large city building cited by Allen Robinson, a well known real estate man in New York at a public banquet recently:

Without Grinnell Protection

Insurance on building \$200,000 at .32 \$ 640 per year
Insurance on contents 900,000 at 1.37 12,330 per year
Total insurance premium without Grinnells \$12,970

With Grinnell Protection

Insurance on building \$200,000 at .15 \$ 300 per year
Insurance on contents 900,000 at .65 5,850 per year
Total insurance premium with Grinnells \$6,150

Saving annually \$6820, by Grinnell protection. Cost to install Grinnell System \$14,500. Thus the system pays for itself in 2 1/2 years and pays 40 per cent on the investment ever after!

OBVIOUS as the economy is when you get the figures, there are thousands of property owners, large and small, who overlook the waste of not having Grinnell protection.

Through companies that specialize in such matters you can arrange to let the Grinnell System be paid for in annual installments out of its own savings, if desired. It usually takes from three to seven years.

Accordingly, if you don't have Sprinklers you are paying for them anyway and not getting the protection.

There are several sprinkler systems on the market but the Grinnell is the oldest, the best, and the best-known, protecting, as it does, more property than all other systems put together.

The Grinnell price is a shade higher but it gets its price right along.

The Grinnell standard is higher than the fire underwriters require. We don't try to see how close we can

skate to the line. We are not content with satisfying minimum regulations. We dare to undertake to approximate infallible fire protection.

Every detail of construction and method is as perfect as a \$6,000,000 organization can make it. Our systems are strictly shop assembled—field work is not good enough for Grinnell systems. We maintain the only research laboratories in the trade and our engineers have been always the major developers of the subtle art and technique of sprinkler engineering. Our thirty-four years of experience in this field is something which the buyer of sprinkler systems cannot afford to be without.

Write—today—to the General Fire Extinguisher Company, 291 West Exchange Street, Providence, R. I., and get a copy of the questionnaire covering the facts which are needed in order to determine how soon a Grinnell System will pay for itself in your particular case. Don't theorize. Get the figures!

Light Tops Lessen Upkeep

WHY put an added tax upon your pocketbook and car? The heavier the top the greater the vibration. Side sway multiplies as the height of the weight above the axle increases. Therefore, every additional ounce of unnecessary top weight means greater strain on springs and bearings, and you pay the bills.

Multi-ply top construction does not signify top efficiency. Extra layers of cloth and combiners diminish flexibility, increase the possibility of cracking in folding and through separation of the various textures tend toward early disintegration of materials.

Theoretically the most efficient top should be waterproof, light and strong, hardy enough to give full service—yet flexible enough to fold without cracking.

**DU PONT
FABRIKOID**
RAYNTITE
SINGLE TEXTURE TOP MATERIAL

puts this theory into actual practice. It is made of a single thickness of light, strong cloth coated with a flexible, waterproof compound that sheds water like a duck's back. It can be easily washed, always looks well, and because it is chemically inert will not oxidize, disintegrate, nor stiffen in cold weather—ideal for the modern one-man top. Guaranteed one year against leaking, but built to last the life of your car. Any top maker can replace your old, dusty or leaky top with Rayntite.



Du Pont Fabrikoid Rayntite will duplicate the remarkable success of Du Pont Fabrikoid Motor Quality—The Standardized Automobile Upholstery—used on 60% of 1916's entire output.

Write for samples and booklets and latest list of cars equipped with this modern top material

DU PONT FABRIKOID COMPANY
WILMINGTON, DELAWARE

Works at Newburgh, N. Y.

Canadian Office and Factory, Toronto

candy maker has endowed a fellowship to learn what he can about possible improvement of his products.

Naturally the smoke nuisance in Pittsburgh readily attracted the attention of these investigators. For three years they tried various methods of lessening the dense smoke clouds that hang over the city before discovering that the carbon particles can be precipitated in the flue by passing a high potential electric current of low amperage through small wires suspended vertically over the mouth of the chimney. The beneficial results of this method are shown by a reduction of smoke in Pittsburgh by at least 35 per cent, with an annual saving of some \$2,000,000.

It will be seen from these examples that the Mellon Institute has passed the experimental stage. Seven out of every ten of the problems submitted have been brought to a successful termination, while in most of the others incidental discoveries have been made of sufficient value to warrant the expense involved. During the past five years 47 different concerns have paid more than \$600,000 for salaries of investigators and construction of experimental plants at the institute. To duplicate independently what the institute has done for them some fellowship donors have said would require an annual expenditure of \$50,000 or more.

As the industries profit by the work of the institute, so does the public profit immeasurably more. Beside adding to the sum total of human knowledge, these workers are getting together information that indirectly will benefit everybody, however remotely connected with our industrial life. Even the discoveries are not indefinitely the property of the donor; in time he, too, must assume the spirit of the investigator in pure science and give free to the world what a fellow in his employ has discovered. While the researchers are acquiring individual knowledge, they are promoting intellectual culture that will contribute to greater industrial success, to the lasting benefit of every one of us.

Artisans of the Motion Picture Films

(Continued from page 211)

any desired level of the ocean bottom. In a certain production, "The World and the Woman," there was to be a garden scene during a thunder storm. One of the features of the scene was a driving rain, while another was a flash of lightning. Whereupon the studio workmen set about to produce the effect desired on the roof of the studio.

An aeroplane propeller was mounted on a substantial base, and to it was applied the power of an electric motor through belting. An artificial garden set was soon arranged and housed in a suitable shelter to make it dark—the photographing took place on a perfect day. Above the set was arranged a trough, perforated with many holes to allow water to drop below. When everything was ready, the electric motor was started, causing the aeroplane propeller to blow up a veritable hurricane through the set. Stage hands, with watering cans, then poured water into the trough, which fell down in the form of rain only to be driven at an angle across the setting. At the propitious moment another stage hand set off a flash-light, giving the desired flash of lightning effect.

All of which bespeaks well of the skill of the artisans of the films. Most of their work is done in wood, although occasionally they resort to metal, as witness the submarine already mentioned. Papier mache, plaster of paris, compressed fiber, and clay are also used in profusion, especially in the making of statues, ornate panels, and other work of a similar nature, forming part of elaborate sets.

The equipment of most motion picture studios is usually such as would do justice to a thriving woodworking shop and machine shop combined. A typical comedy-producing studio in southern California, for instance, has over \$2,000 worth of woodworking equipment for its carpenter shop, while the lumber constantly at hand and other items are said to bring

the total up to \$4,000. The concern employs regularly over 75 carpenters.

Building Interiors to Fit the Story

The interior settings of a film play require the closest attention on the part of the producers. For here again the constant demand for accuracy and realism is paramount. The smallest details must be watched. If the director calls for a tenement house scene, the stage carpenters must build him a dilapidated hall and stairs, and small, squalid rooms. The scene must appear much the worse from wear—the steps must look worn, the walls must be marred with here and there a hole in the plaster, and there must be dirt aplenty. Again, if the director calls for the home of a rich man, it is necessary that he state what kind of a rich man the film author had in mind. Is he a wealthy man from a family of long standing, or a *nouveau riche*? If he belong to the former class, the furnishings are to be of a quiet, harmonious design, with the paintings and other ornamentation typifying good taste; while if he belong to the latter, the furnishings must be of a garish design. In that way does the motion picture producer endeavor to amplify the type of man whose home is represented.

Obviously, it would not do to leave the selection of furnishings and their proper arrangement to stage hands and carpenters; and accordingly the demand for accuracy and realism has brought into existence a new type of executive in the film industry—the technical director, or art director as he is sometimes called. To him falls the task of reading through the synopsis or scenario of a story that is to be produced, and the supervision of the erection of sets. He is responsible for the arrangement of all sets, even to the smallest details, as well as for the costuming of the players, and other details. However, he is not responsible for the action part of a scene; that remains, as ever, the work of the director.

The technical director must be a veritable human encyclopedia—a man of remarkably broad experience. He must be well read; and what he does not know he must be able to "dig up" at short notice. Here is how his knowledge is applied: If a scene is laid in a certain country and the time is of a different century, he must know what garments the players are to wear, the accoutrements of the soldiers, the etiquette of the period and country, the furnishings for the interiors, the head dress of the women, and a thousand-and-one other details.

Perhaps actual incidents are most convincing in illustrating how the directors strive for accuracy, and how the absence of technical direction may be fatal to an otherwise perfect production. The story is told of how Irvin Cobb, the noted writer, was visiting a prominent Los Angeles studio. A director was rehearsing a scene of a war play in which a regiment of German soldiers were marching through a Belgian village. To add a touch of comfort and naturalness, the director had the men leave their coats unbuttoned. Mr. Cobb, only recently arrived from the war zone, was horrified at this gross misrepresentation of facts. He did not hesitate to tell the director that at no time do the Germans have their coats unbuttoned while actually on duty. The director was grateful for the tip, for he realized the humiliation that might have been his if the otherwise perfect scene were held up to ridicule by the better-informed of the millions who would ultimately view the picture. At the same time the author also commented on the wearing of the Iron Cross decoration, which the director had insisted the men should wear conspicuously, whereas it is usually tucked away with only its ribbon showing. Can there be any doubt of the necessity of the technical director?

To return to interior settings: These represent one of the big items of expense in the production of a film. One reason is that the average set can only be used in one production, after which it must be destroyed. In the earlier days the audience might not have commented on seeing

the same furniture used several times; but to-day they will soon detect any attempt to use the same lamp, settee, or other furnishings repeatedly. Repetition has got to be avoided by the producers. And as in the case of the garments worn by the players, the furniture must be in keeping with the last word in interior furnishings. Every studio maintains a large room or several rooms in which an almost endless variety of furnishings is stored.

The walls of an interior set are generally built of compressed paper or board, backed up by framework and props, to facilitate the work of erection and destruction. Tremendous quantities of the necessary materials are employed annually, as witness some 50,000 feet or more of compressed paper board used by a leading comedy producer, together with over 500,000 feet of lumber. The same concern spends over \$1,800 for some 15,000 rolls of wall paper each year, with which to decorate the walls of the sets.

The cost of even the most modest set runs up into the hundreds of dollars, for it must be remembered that practically each set must be built and decorated to order, and filled with the necessary furniture which may not be used again for a long time to come. Elaborate scenes run up into the thousands of dollars; for instance, a good restaurant or cabaret scene may cost from \$2,000 to \$5,000, depending on its elaborateness and size. It is said that the café set in the comedy "His Pride and Shame," with the comedian Ford Sterling, cost \$4,000. In the recent production of "Macbeth," starring Sir Herbert Beerbohm Tree, the witches' scene alone cost upward of \$10,000, owing to the intricate electric lighting equipment for producing the weird fire effects.

In the Land of Two-Dimensional Structures

The film artisan finds his biggest field of endeavor in the outdoor sets, for under the open skies the undertakings are not hindered by space limitations and can therefore assume the most gigantic proportions. Here again, the striving for realism is the first consideration; here the technical director must exercise his knowledge of architectural design covering every period of history and every part of the world.

Perhaps the greatest set that has ever been constructed appears as the heading illustration of this article. On the front of this huge setting—the side that faced the camera—are gigantic walls painted to simulate stone, 100 feet high and adorned with reliefs of strange winged creatures and elephants, suggestive of the architecture of ancient Babylon. The towers of the set stand 135 feet high, and the various structures cover a ten-acre tract of land in Hollywood, California, just outside Los Angeles. For more than six months the carpenters, masons, concrete workers, and painters were busied with the set, and the cost of the work is reported to have been in excess of \$50,000. The setting has been used for a production entitled "Intolerance," produced under the direction of D. W. Griffith. In the number of people employed the film is said to outrival the American classic production "The Birth of a Nation," which was produced by the same master director.

But slightly less pretentious was the set erected at an approximate cost of \$35,000 by Director Thomas H. Ince, who is a leading advocate of elaborate, realistic settings. This set represents the palace, house of parliament, prison, royal court, and adjacent buildings in a mythical country. The first spadeful of earth in preparation for the erection of the set was turned in May, 1915. The completed set was ready for use in November of the same year. Into its construction went 30 carloads, or approximately 600,000 feet, of lumber. Glass valued at a total of \$4,000 was necessary for the several hundred windows, while tons upon tons of cement and plaster were used as the other principal materials. For the steps of the largest building alone ten tons of cement were used. The sidewalks, with

their curbs, measured some 1,200 feet, and 20 men were employed for three months laying them out and arranging the parkings between them. Trees, shrubbery, and lamps were among the ornaments placed within the boundaries of the set. Covering an area of over six and one half acres, the set still stands atop one of the hills in southern California, enduring the elements successfully as though it were intended as a permanent structure. At this very moment the films for which it has served its purpose, the photoplay "Civilization," is being shown to audiences throughout the country.

It is principally in portraying foreign scenes that the film artisans are called upon to build elaborate sets. Years ago, before the industry had reached its present high state of development, companies traveled abroad in order to produce the plays at the actual locations called for in the scenarios. To-day, in marked contrast, the producers find it easier to bring the foreign or distant spots to the studio, literally speaking. Accuracy enables them to convince the audience that the scenes are laid in the country called for by the story. All parts of the world have been brought to the foothills of California, the shores of Florida, and the edge of the Palisades of New Jersey, where the producers have better laboratory facilities, understand the light better, can secure experienced players—and save time.

Typical instances of foreign sets are the barracks of Delhi, India, and a street in a village of a mythical country, recently erected and used by a Western producer. The former consisted of seven individual structures and entailed an expenditure of \$3,000; the latter represented a street scene, lined with houses of solid construction, being made of plaster-covered timbers, while the stone walls and trees were handled with great care to obtain correctness of detail. The entire set required about six weeks to build and involved an outlay of perhaps \$5,000.

There is practically no end to the elaborate outdoor sets erected by moving picture producers. In the production of "Ramona" it is claimed that over 1,800 sets were especially built for the play. The picturesque Spanish monastery for one of the sets is said to have cost \$10,000.

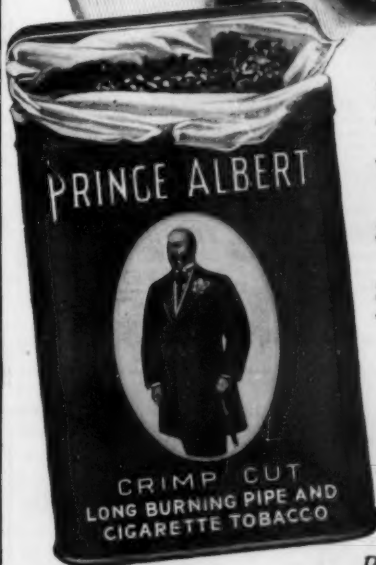
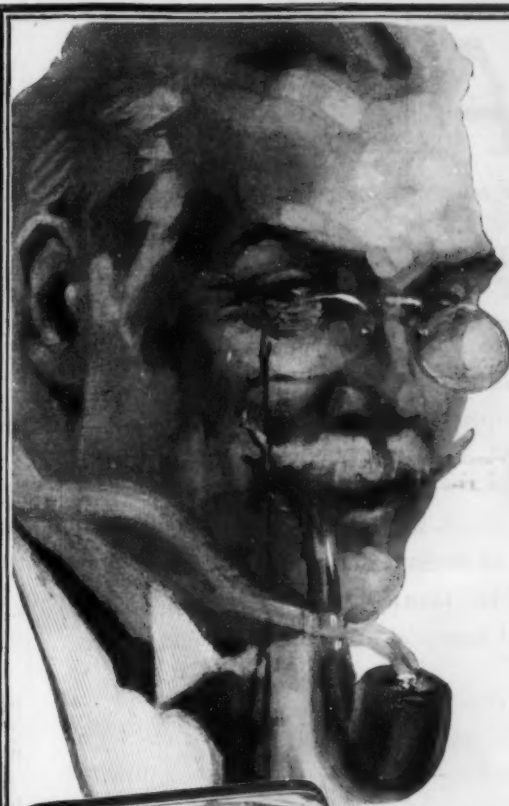
A commendable piece of work is the set representing the temple of an Aztec monarch in the sixteenth century, which was used in the production "The Captive God." Its framework was built of timbers, but the body was of plaster plaques. About 7,000 of these plaques were required, and the total cost of the set is said to have been \$3,000.

A set representing a border town on the line separating Mexico from the United States, for use in a typical Western drama, was recently constructed at a cost of \$1,500. It consisted of about 15 buildings, each entirely of frame construction. While the cost of the village was not great, it is regarded by film men as one of the most remarkably realistic sets ever built for the screen.

All of which means that the production of motion pictures is a costly enterprise if realism is to be had. Also, there is to be found no more skilled and ingenious artisan than the artisan of the screen, whose work plays so conspicuous a part in the remarkable productions of to-day.

Shadowless Mirror

WHEN a mirror is used with artificial light, it usually happens that one side of the face is left in shadow, or in any case it is not easy to have the entire face well lighted. The present mirror is designed to provide uniform lighting all over the face of the person. A funnel-shaped holder of good size is mounted so as to swing on pivots as well as to raise and lower, so as to have a good adjustment. It has an inner reflecting surface, either polished or a dead metal or white surface. An electric lamp projects into the back part, and the mirror is suspended within the holder by means of wires.



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Add to this bunch of smoke-satisfaction that Prince Albert can't bite or parch! Bite and parch are cut out by the exclusive patented process by which Prince Albert is made!

Get the facts fast and straight as we bat-'em-out, then lay in a stock of P. A. and get going! You can't any more keep a smoking man off the Prince Albert firing line than you can make a kiddie believe candy isn't good!

Sure as you're a foot high, you'll cheer for P. A. quick as you swing-in a few loads! Then, you too, will be singing that happy ditty:—"The only match for Prince Albert is the one you fire-up with!"

R. J. REYNOLDS TOBACCO CO., Winston-Salem, N. C.

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The Meaning of MAZDA

MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this Service. MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady.

The mark MAZDA can appear only on lamps which meet the standards of MAZDA Service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.

RESEARCH LABORATORIES OF
GENERAL ELECTRIC COMPANY

4628



American Aviators with the French Army

(Concluded from page 203)

landing though the machine was completely wrecked. Balsey explains that his machine gun jammed during the second rush of the Germans. He is now in the American Ambulance Hospital in Paris. His wound is not believed to be dangerous, but the doctors say he will never fly again.

Just after these two men had fallen, when things looked bad for the American squadron, reinforcements of French machines came up. The Germans were soon driven back across the lines and the engagement was over. One German machine was destroyed and its two occupants killed and others injured. The French suffered no casualties except the wounding of Balsey and the loss of his machine.

The American aviators are not reckless or foolhardy, but brilliant flyers who use their heads. They continue to be very active despite unfavorable circumstances such as repeated bombardments of their camps and hangars by German aviators. The Germans try constantly to draw out the Americans. At Belfort they sought to get them at a disadvantage, and again just recently in a raid on Bar-le-Duc.

In this latter engagement the Americans ascended as the invading squadron's approach was telephoned from the firing line. They met and opened fire directly over the French hangars at Bar-le-Duc. The Germans again outnumbered them two to one. Both the French captain and Prince were forced to come down, one with a punctured gasoline tank and the other with his ammunition box blown off by explosive bullets. Soon after Cowdin's machine gun choked and he too descended, leaving Hall and Chapman to fight off the Germans alone until reinforced by a French squadron from Toul. They were then able to force the Germans back into German territory and inflict heavy losses though no injuries were suffered on the French side. Several buildings were struck in Bar-le-Duc, and an American ambulance section was kept busy picking up the wounded, most of whom were civilians.

The Americans are equipped with small Nieuport biplanes, called "the Hunter" or "Aeroplanes de chasse," which is the fastest machine in the French army and is so small that it is very difficult to handle both in getting away and landing. It is most flexible, however, when in flight, with turning, twisting, dodging and climbing ability far superior to that of the German Fokker used for the same purpose.

The Nieuport is a one-man biplane. The pilot is seated just back of the motor and the planes, with his stationery machine gun on the top plane just in front of him. He operated the gun by means of a release at his side. The gun being stationary, aiming is accomplished by maneuvering the machine into position. The preferred attack is from behind and below the adversary.

Operating these machines is the most difficult phase of aviation. All the responsibility falls on one man, who, to be successful, must possess the greatest skill and courage.

The color of the machine is a mottled green and brown irregularly striped with black. From above these colors blend into the landscape and are practically undiscernible.

The Americans say their duties are comparatively simple. They are to keep the German airmen from crossing the French line. Whenever and wherever they meet a Fokker or an Aviatik they are to bring him down or force him to turn back. If they can do this without sacrificing their own lives or machines so much the better. But it must be done.

Among those who have been most successful is Lieutenant Thaw. He has fought sixteen battles and brought down five adversaries. His machine received several bullets while over the German lines at Verdun, one of which hit him in the elbow, breaking a small bone. He

has recovered and is again with the Corps.

Sergeant Kiffin Rockwell destroyed a German plane on May 18th, and attacked several on May 26th, when he was badly wounded in the face. He brought down two German machines during a battle at Verdun.

Sergeant Bert Hall, after a long, hard fight on May 22nd, brought down a German from a height of thirteen thousand feet. He followed it down three thousand feet and saw it crash to the ground just within the German lines.

Perfecting a Fire-Proofing Solution

(Concluded from page 212)

ammonia, and when made with pure chemicals is colorless. Otherwise it has a yellowish tinge. The exact chemical composition will not be revealed until the patent has been granted and the preparation has been put on the market.

Materials, of course, are not entirely unaffected by fire. They are charred somewhat, but the texture remains. The value of the preparation lies in the fact that treated materials cannot be made to burst into a flame; hence they cannot carry combustion. Even when soaked in alcohol, ether, or gasoline, the combustion ends when these highly inflammable liquids have burned out of the wood or paper.

The substance is also a preservative. The insoluble mineral residue renders materials more durable, and in many cases doubles their wearing power. There are approximately 900,000,000 railroad ties in use in the United States. They have to be renewed once in every nine years—about 100,000,000 being replaced every year. If treated with this liquid, say the inventors, it is reasonable to suppose they may be made to last twice as long.

The commercial possibilities of this discovery are far reaching and unmeasured. All kinds of building materials can be protected; pine shingles will be as safe as slate. It is estimated that 90 per cent of the fires in ordinary dwelling houses start in the roof, and men interested in the manufacture of shingles have written many letters to the inventors. The manager of one of the largest circus companies in the country offered the inventor \$10,000 for the treating of his tents alone. Manufacturers, lumber men, circus and theatrical managers and promoters have deluged the three Iowa men with offers. An important use will be the protection of fibre shipping boxes, to judge from the offers received from the manufacturers of this commodity. Curtains, carpets, rugs and wall-paper can no longer spread a blaze started with the lighted cigarette in the waste-paper basket or the overturned lamp. Public buildings—theaters, hotels, hospitals, schools and factories—may be practically rendered immune from the ravages of fire.

And all this at a nominal cost. It is safe to assert that the price of the preparation will be negligible, compared to the saving of life and property that will result.

Industrial Preparedness for Peace

(Continued from page 214)

shape and appearance of an overgrown blacksnake whip, and from the bulbous end long streamer-like leaves float idly in the water. The roots cling to rocks on the sea bottom, anchoring the plant against wind and wave. A fully matured kelp plant is about 300 feet in length, and requires about 70 days to attain this state. Not only is the growth very rapid, as this would indicate, but the plant is hardy to the point of indestructibility. An investigator at the Puget Sound Marine Station, after noting that mutilation of the blades interfered in no wise with their growth, went on to ascertain just what could be done to the plant without fatal results. She found that small pieces of the blade continued to grow when tacked to a submerged raft, and that pieces little more than one millimeter square, when submerged in canvas bags, more than doubled their lengths in ten days. She also made it clear that the plant grows twice as

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But be very sure that you will form a strong and definite opinion one way or the other. The reason for the constant changing in brands among cigarette smokers is a certain soft neutrality of flavor characteristic of most varieties. The only variation in placid mediocrity is on the box. If almost any decent brand satisfies you, you probably will not care for Rameses, "The Aristocrat of Cigarettes."

But if you are seeking a very definite and distinctive cigarette, unlike others—unforgettable—the one cigarette for your personal and individual taste—then you are coming to Rameses.

Soon.

Remember, Nobody ever changes from Rameses.

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Shot flatten when driven at this high speed into an improper choke.
Flat shot fly wild and make a poor pattern.
Our taper choke gives a close, hard hitting pattern.
Ask your father, grandfather or any man who owns one.
Shooting qualities guaranteed.
Catalog FREE—double guns, \$17.75 up; single trap guns, \$8.50 up.

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Manufactured by VOLNEY W. MASON & CO., Inc.
Providence, R. I., U. S. A.

fast in the daytime as it does at night.

In spite of this rapid and persistent growth, the Federal government has deemed it wise to take control of the kelp beds to insure that the plant is merely cut, and not removed bodily from the water. The weed is harvested frequently, and usually to a depth of from one to three fathoms (6 to 18 feet). This operation is accomplished from scows by big steam-driven harvesters which work much like a reaper in a field or a steam shovel in a ditch. One such harvester is now in operation possessing a capacity of a hundred tons per hour. Gathered in this way, the kelp costs from 20 to 40 cents per ton, delivered at the dock.

The expense of converting the raw wet kelp into potash varies with the character of the plant and its equipment. At the present moment this item is a matter of complete indifference to those engaged in the industry; with potash selling at \$600 a ton as against a normal time-of-peace quotation of \$35, the manufacturer need not be at all concerned about his cost of production, or the complete utilization of his raw material. A Freshman in a decently equipped college laboratory could produce potash at a profit under such conditions.

But these conditions, while they may endure for an indefinite period, will not be permanent. In spite of all appearances, the war will end. In spite of all talk about blacklists and trade rings, Germany's natural resources will once more be at the world's disposal.

And what then? We have the raw material. The problem confronting our manufacturers, the problem which, under penalty of dismantling their plants and going out of business, they must solve before the end of the war, is that of getting manufacturing costs down to a point at which the American product can compete with the foreign. In the potash business as in few others, the American manufacturer has a golden opportunity to use the present halcyon days in anticipation of the keen competition and era of profit-shaving and cost-shaving to come.

There will probably be found a solution of the problem—there may have been found a solution already, in fact. Perhaps the plant that will best meet the demands of low-cost production will be a portable, floating one—one which can seek the richest kelp beds, harvest and work up the crop on the spot, eliminate waste by converting the stalks into some form of marketable fiber, and carry the finished products to the nearest market. If we can have floating salmon canneries, why not floating potash factories? Indeed, a plant of this character is reported to be in operation from Seattle now, but the alleged owners refuse to comment upon the rumor, and no photographic evidence is forthcoming.

It is of more than passing interest to note that kelp is the fundamental source of the potash we have been importing. The German potash fields were once seas. Drained by volcanic activity, they were converted into vast stretches of dry land covered deep with stranded seaweed, which presumably was in the same ratio of size to the present-day kelp as all vegetation of the early periods to that of to-day. The earth's heat reduced this to ash, and left Germany this rich natural resource.

American Trade Marks and Patents in Peru

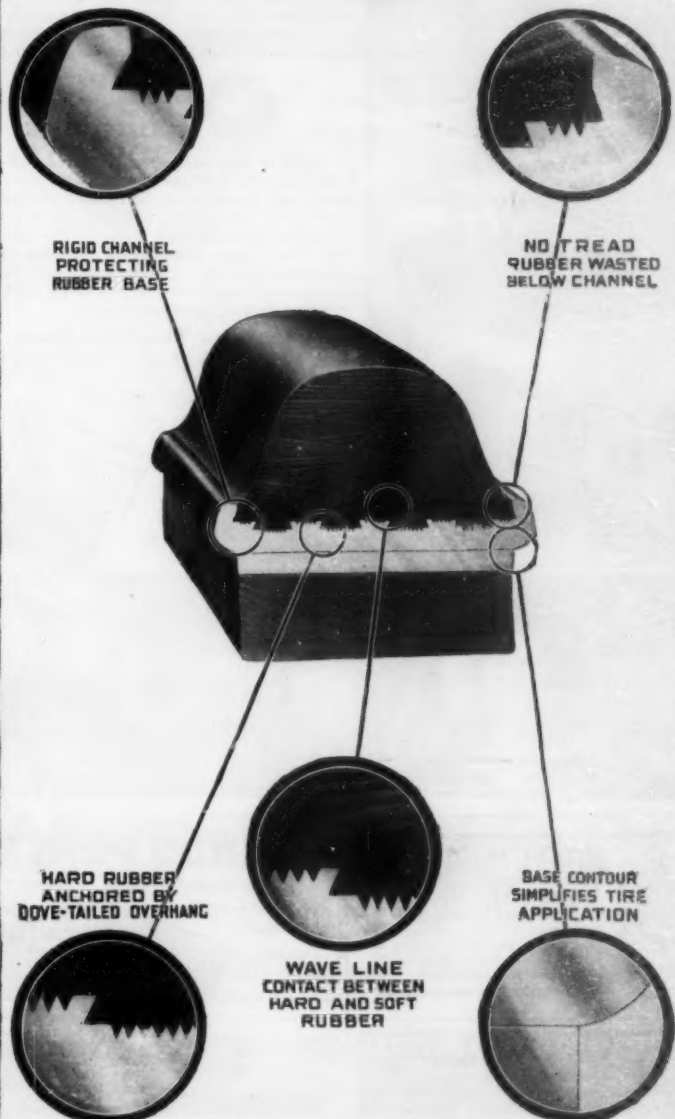
ACCORDING to a report made by the Ministerio de Fomento to the Peruvian Congress in August, 1915, the number of trade-marks registered for the year 1914-15 was 286, as against 406 for the year 1913-14.

Notwithstanding this decrease, the number of marks emanating from the United States increased not less than 50 per cent.

The number of patents granted during the year was 95, a record number, as against 51 for the preceding year. More than 40 per cent of these were for improvements invented in the United States.

GOODRICH DE LUXE TRUCK TIRES

(Made in 5-in., 6-in. and 7-in. widths)



DE LUXE

The tire of extra volume, durable, resilient tread rubber. Experiences of truck operators in all parts of the country prove it the biggest *mileage giver* in all forms of exacting truck service.

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The B. F. Goodrich Company
AKRON, OHIO

Makers of the Celebrated Goodrich Automobile Tires—
"Best in the Long Run"

Service Stations and Branches in All Important Trucking Centers

NEW BOOKS, ETC.

THE MARINE STEAM TURBINE. A Practical Description of the Parsons and Curtis Marine Steam Turbines as Presently Constructed, Fitted, and Run. By J. W. M. Sothorn. New York: D. Van Nostrand Company, 1916. 8vo.; 561 pp.; illustrated. Price, \$6 net.

Since the first edition of this work improvements have been steadily made in marine steam turbine design. These improvements are very thoroughly taken up and described in this latest edition, noticeable among them being the use of gearing between the propeller shaft and the turbine with the object of attaining a maximum efficiency of both turbine and propeller, and the combined impulse and reaction turbine, which has given excellent results in marine tests. The entirely new material of the volume relates mainly to impulse turbines and geared-down turbines, with a brief discussion of entropy. The author admits that he has laid himself open to the charge of repetition and overelaboration, but for this the reader whose knowledge of the subject is scanty will be duly thankful. The volume is intended for the use of students, draughtsmen, works managers, and naval and mercantile marine engineers, and these may turn to the volume with assurance that the mass of data it contains is not only extensive, but accurate and well arranged. It constitutes a complete manual of practice, and its profuse diagrams, photographic reproductions, and detail drawings will prove of the greatest help to the reader in reaching an intelligent understanding of principles and design. The data and the conclusions of the volume are drawn from actual working results, and the effort toward reliability of statement is everywhere marked. As the author points out, it has taken the turbine but a dozen years to arrive at a degree of efficiency similar to that which the reciprocating engine took a century to achieve, hence further successful progress may confidently be looked for.

TWENTY-NINTH ANNUAL REPORT OF THE BUREAU OF AMERICAN ETHNOLOGY. 1907-1908. 4to.; 636 pp.; illustrated. Washington: Government Printing Office, 1916.

THIRTIETH ANNUAL REPORT OF THE BUREAU OF AMERICAN ETHNOLOGY. 1908-1909. 4to.; 453 pp.; illustrated. Washington: Government Printing Office, 1915.

The first of these volumes is taken up, aside from the administrative report, by a long paper on the ethnogeography of the Tewa Indians of the Upper Rio Grande Valley, New Mexico. The Tewa are a secretive tribe, and it was not without difficulty that they could be induced to bare their cosmographical and religious ideas. The rich array of information speaks eloquently for Mr. Harrington's earnestness and patience. The Tewa universe, meteorology, periods of time, and geographical terminology are all set forth at length, their language sounds are explained, and a rather extensive bibliography is appended. In the Thirtieth Report, two extremely interesting papers are published. These are "Ethnobotany of the Zuñi Indians," by Matilda Cox Stevenson, and "An Inquiry Into the Animism and Folk-Lore of the Guiana Indians," by Walter E. Roth. The first explains the use of plants in medicine, industry, the toilet, and folk-lore; the second presents an intensely interesting series of myths and folk-tales, in some of which we notice close parallels to those of the "Metamorphoses" and "The Arabian Nights." All the papers are distinct contributions that cannot but promote a better understanding of the Indian mentality, and of the environment that, influencing his mental processes, has in turn been so interpreted by them as to give rise to the characteristic tribal habits and customs.

HOPWOOD'S LIVING PICTURES. Their History, Photo-Production, and Practical Working, with Classified Lists of British Patents and Bibliography. By R. B. Foster, B. Sc. New York: Munn & Co., Inc. 8vo.; 377 pp.; illustrated.

The progress of the moving picture has been nothing short of a triumphal march. The subject is of such intense interest, whether we regard it from a technical or a popular point of view, that a little retrospect is not only pardonable, but welcome. The work in hand traces the origin of the moving picture back to the first toy to utilize the principle of persistence of vision, and the author has subjected every statement, from beginning to end of the book, to painstaking verification. The reviser has carried on this critical scrutiny with commendable results, and it is not necessary for the reader to be technically informed in order to appreciate the mechanisms and methods set forth. The historical portion of the work very thoroughly covers film machines and intermittance devices, the production and treatment of the film itself is clearly described, and the section on exhibiting deals with the projector, the optical system, illuminants, screens, safety devices, and all the modern refinements that have brought the art to its present state of perfection. There is a fascinating discussion of color cinematography; living and speaking pictures are dealt with in such fashion as to make intelligible to the reader the difficulties of synchronism and the efforts which have been made to overcome

A Time-Conservation Service

for your own organization—



A few years ago in the neighborhood of every gold mine was a hill of worked-over ore or "tailings."

Mine operators knew that these "tailings" still contained some gold, but they knew also that it would cost more than the gold was worth to try and reclaim it with the methods and equipment then at their command.

With the aid of improved methods and equipment, mine owners have found that the CONSERVATION of the apparently small percentage of waste gold which used to go into the "tailings," adds millions to their total output every year.

Approximately one week per year of the time of every telephone user in your organization is slipping through as "tailings" which can easily and profitably be conserved with the aid of the AUTOMATIC TELEPHONE.

Over eighty per cent of the traffic through the average private switchboard is composed of calls between members of the same organization.

The time consumed in getting the operator's attention, giving the desired name or number, its repetition by the operator, the making of the connection by cords and plugs, and finally ringing the called party's phone—has been found to average 25 seconds per call.

The Automatic Telephone requires no operator. Simply lift the receiver—turn the dial at the base of the instrument (see illustration above) for the desired number—and the bell of the called phone rings instantly, automatically and intermittently until the phone is answered or you disconnect by hanging up the receiver.

The maximum time will not exceed seven seconds—a clear saving of at least 18 seconds on every call. Multiply by 30, the average number of intercommunicating calls per instrument per day—then by the number of telephone users—then by the average wage—and the huge dollar-and-cents value of AUTOMATIC intercommunicating service begins to become apparent.

In addition—

The Automatic insures absolute secrecy—no one can possibly "listen in"—no one need even know the number you are calling.

The service is perfect—no wrong number—no broken connections while you are still talking—no delays.

A private conference may be held over the Automatic between any number of persons.

The Automatic is in service 24 hours a day—365 days a year.

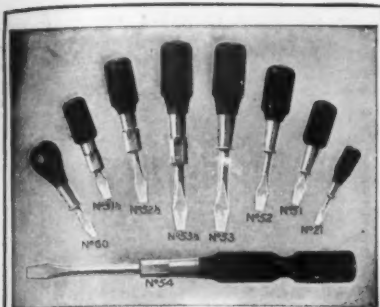
The subject warrants your further investigation. A request over your signature will bring you a manual, "Your Telephone—Asset or Liability," which has been carefully prepared for the consideration of executives. Instruct your secretary to send for a copy today.

Automatic Electric Co.

Makers of 600,000 Automatic Telephones in Use the World Over.

Dep. 94 Morgan and Van Buren Streets, Chicago.

New York Toledo Buffalo Pittsburgh Detroit Philadelphia Boston St. Louis London Paris Berlin Sydney, Australia Winnipeg, Canada



"Hurwood" Screw Drivers

Unsurpassed for Strength and Durability

Blade, Shank and Head—one piece of special steel, finely tempered. The Blade cannot turn in the Handle.

The Assortment illustrated above is well worth your attention.

For instance—No. 21 shown at the extreme right of the picture—blade only 1 1/4 inches long, just fits the vest pocket, a strong little Driver and very handy.

Also No. 60—shown at the left—only 1 1/4 inch blade but with a big, sure grip handle. For heavy work into close corners it cannot be beaten. Used by Plumbers, Machinists, Millwrights, etc.

No. 51, 52 and 53—Called MACHINISTS' DRIVERS—big, broad tips for large screws and extra large shanks for heavy work.

No. 51 1/2, 52 1/2 and 53 1/2—also Machinists' Drivers, have hexagon nut on shank for use with a wrench.

No. 54—Note the DOUBLE GRIP, also the hexagon feature for wrench. With this latter Driver one can turn anything.

We make many other drivers. See Catalog No. 34.

STANLEY RULE & LEVEL CO.
NEW BRITAIN, CONN. U.S.A.

This Says
376 Thousandths
Of An
Inch
And It's Right

YOU can absolutely depend upon the accuracy of any Starrett Instrument. It is this accuracy that made them the standard of the world.

Starrett Tools

Include 2100 styles and sizes of fine tools and instruments. To know the complete line is to make many valuable additions to your tool kit. Send for free catalog No. 20-B.

THE L. S. STARRETT CO.
"The World's Greatest Tool Makers"
Athol, Mass.
New York London Chicago

Veeder Counters

SMALL SETBACK
(Ratchet or Revolution)
RESET TO ZERO BY A SINGLE TURN

These counters are just as high grade as our large counters, but are lower in price. Price \$1.

It will pay you to Veederize your machinery and know just what is going on.

Any mechanical engineer will tell you that the word Veeder stands for the best constructed and most accurate counting devices in the world.

Cyclometers, Odometers, Tachometers, Fine Die Castings, and all kinds of counters.

VEEDER MFG. CO.
18 Sargeant St., Hartford, Conn.

TRUMP JACKS

\$5 for a Set of Four Adjustable FOLDING TIRE SAVERS

RELIEVE the strain on your tire casings and save many inconvenient blowouts. The cotton fabric in your tires will not stretch and the strain of standing still is the most severe strain on the fabric.

LIFT the weight of your car off your tires. You'll get more mileage out of them if you stand your car on TRUMP JACKS every night. It's easy to do and only takes thirty seconds.

Raise your tires off the floor and prevent the oil, water or dampness from softening your tire shoes.

Ask us how Trump Jacks can be used when removing tires. Trump Jacks will stand hard usage for many years and are adjustable to any hub.

Send for a free circular and look into this. A special money-back guarantee with set.

THE TRUMP PRODUCTS COMPANY
Carland Bldg. Chicago, Ill.

—to prevent infection of cuts, blisters, scratches, and abrasions, use

LISTERINE

The Safe Antiseptic

TUNGSTEN PRODUCERS OF SCHEELITE ORE TUNGSTEN

LARGE STOCK ALWAYS ON HAND
FIFTY PER CENT W. O₂ OR BETTER

ATOLIA MINING CO.

OFFICE, 1404 HUMBOLDT BANK BUILDING
SAN FRANCISCO

WAREHOUSE, PITTSBURGH, PENNSYLVANIA

MINES:
ATOLIA, CALIFORNIA
AND
LOVELOCK, NEVADA

TUNGSTEN TUNGSTEN

Pulmotor

The Protected Trade Name of a Notable Saver of Human Life

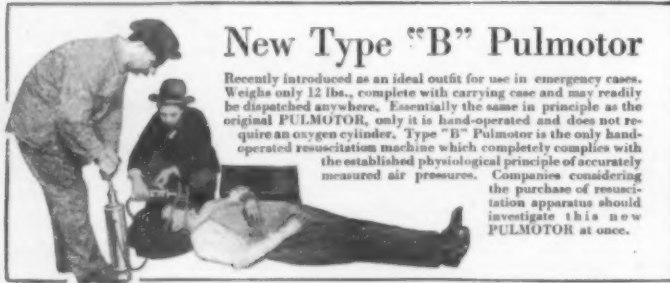
Coupled always with the dramatic it is only natural that the name PULMOTOR should have burned itself deep into public consciousness in its eight golden years of service to humanity.

Once the only device of its kind, PULMOTOR has been followed by other resuscitation devices similar in name while different in principle and operation.

In order, therefore, for users of resuscitation apparatus to be sure of those proven features of PULMOTOR construction to which must go the credit for saving thousands of human lives, it is necessary to call attention to the fact that—

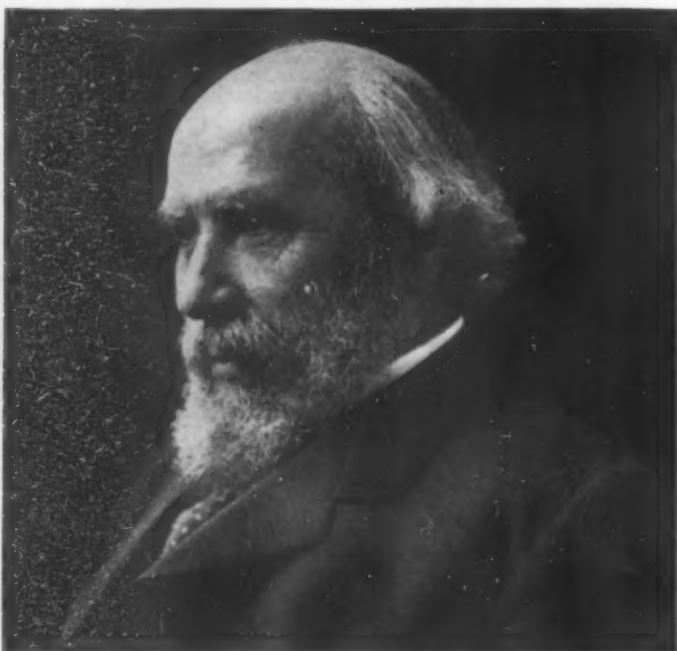
*There is only one genuine PULMOTOR—
the genuine always bears the name DRAEGER*

THE DRAEGER OXYGEN APPARATUS COMPANY
418 First Avenue Pittsburgh, Pa.



New Type "B" Pulmotor

Recently introduced as an ideal outfit for use in emergency cases. Weighs only 12 lbs., complete with carrying case and may readily be dispatched anywhere. Essentially the same in principle as the original PULMOTOR, only it is hand-operated and does not require an oxygen cylinder. Type "B" Pulmotor is the only hand-operated resuscitation machine which completely complies with the established physiological principle of accurately measured air pressures. Companies considering the purchase of resuscitation apparatus should investigate this new PULMOTOR at once.



LIFE OF JAMES J. HILL

The World's Work announces that it will publish serially, beginning in October, the authorized biography of the last and greatest of the Empire Builders.

This graphic and absorbing life of the most constructive and far-sighted American of his time was written with Mr. Hill's approval and from his personal papers and letters by his friend—Joseph Gilpin Pyle.

Begins in the October

WORLD'S WORK

\$3.00 the year

25 cents a copy

A Suggestion

New readers may have an introductory subscription of six months for one dollar. Just write your name and address on the margin—pin a dollar to it and mail this at our risk to DOUBLEDAY, PAGE & COMPANY, GARDEN CITY, N. Y.

Sci. Am. 9-2-16

these difficulties. The classified list of British patents should be of distinct value to inventors and manufacturers, and the substantial bibliography provides a key to the literature of the motion picture.

THE BIRTH-TIME OF THE WORLD. And Other Scientific Essays. By J. Joly, M.A., Sc.D., F.R.S. New York: E. P. Dutton and Company. Svo.; 307 pp.; illustrated. Price, \$3.50 net.

In each of these essays there appears enough of the speculative to excite wonder and maintain interest, but beneath the speculation is ever a solid foundation of attained fact. The subject of the age of our world is of importance from its connection with the longevity of planetary systems. Here the most recent additions to our knowledge are taken into account. This paper is followed by a general survey of "Denudation," with a popular account of the method of finding the age of the ocean by its accumulation of sodium. In "Other Minds Than Ours?" we find an attempt to explain the canals of Mars by the gravitational stresses exerted by the action of near satellites upon the Martian crust. A large insert lays out these calculated stresses, superimposing their lines upon the courses of the canals, and the close approximation of the two charts is somewhat startling. In "Skating," the author raises the question as to why we can skate upon ice, and upon no other substance, and shows that the popular answer, "Because ice is so smooth," is not borne out by the facts. He concludes that we really skate upon water, and not upon ice, and his experimental methods of reaching this conclusion are most interesting. All the papers are well worth reading, and most of them have an element of popular appeal.

PRINCIPLES OF ACCOUNTING. By Stephen Gilman, B.S. Chicago: La Salle Extension University, 1916. Svo.; 415 pp.; illustrated.

Seldom does the student find a textbook on accounting which presents the basic principles so that he may grasp them effectively and apply them efficiently. Obediently, he makes given entries under a given set of circumstances, only to find that the slightest variation in conditions befogs him as to the application of the rules. It is not enough that an instructor know how himself; it is quite as important that he know how to express his knowledge in terms that the student can understand. It is here that Mr. Gilman's contribution to the La Salle course in business administration shows its worth. The why and wherefore of the double entry is graphically explained in unforgettable symbols, so that no careful reader need dread the problems it presents. The student is soon led beyond the mere bookkeeping of former days to the analytical study and terse expression demanded by the accounting of to-day, which has lately taken such a commanding position in industrial and financial circles. Mr. Gilman continues the use of charts and diagrams in showing the relation of various accounts to each other, until by the time we draw near to the end of the book, we are being initiated into the mysteries of holding companies, their organization, and the methods of stock transfer and control.

POLYGLOT RUBBER TRADE DIRECTORY. United States and Canada. 1916. New York: The India Rubber World. Svo.; 421 pp. Price, \$3.50.

A most commendable innovation is embodied in this, the third issue of the Rubber Trade Directory: former editions, printed entirely in English, presented difficulties to foreigners unfamiliar with our language; now, not only are the preface and plan of the book set forth in French, Spanish, German, Portuguese and Italian, but equivalent "key letters," translated into terms of the above languages, clearly show the nature of the goods listed. Another noteworthy feature of the work is the compilation of trade-marks, and trade names and designations adopted by rubber goods manufacturers. The lists aim at covering the entire trade of this country and of Canada, and to include corrections and trade changes to within a week or two of publication. There is a list of the concerns incorporated since January 1st, 1915, which have in their charter any reference to rubber or the rubber trade. All importers, buyers and sellers of rubber, and all manufacturers into whose output rubber enters even in slight degree, will find the directory a most useful and reliable guide in any question concerning the location of firms or materials.

ENGINEERING DIRECTORY. 1916. Chicago: The Crawford Publishing Co. 2 vol. Vol. I, 16mo.; 896 pp. Vol. II, Svo.; 490 pp. Price, \$6.

Part I of this publication is known as the Seller's Guide, to be used by manufacturers as a calling or mailing list; it presents a very complete and accurate list of jobbers and dealers in mill, steam, mine and machinery supplies; a new feature is a compilation of plumbing and steamfitting contractors, classified by states and cities, and there are further lists of wholesale dealers in hardware and of manufacturers' agents. Part II is known as the Buyer's Guide, and is a comprehensive directory of manufacturers in the lines indicated above, the products of 7,000 of them being classified under 4,000 headings. The arrangement of the information offered by

these directories allows of various conveniences, such as the prompt location of manufacturers from a trade or brand name, and an article known by more than one name may readily be found by referring to the cross index.

TABLES OF PROPERTIES OF OVER FIFTEEN HUNDRED COMMON INORGANIC SUBSTANCES. By Wilhelm Segerblom, A.B. Exeter, N. H.: Exeter Book Publishing Co., 1916. Svo.; 144 pp.

Any student of qualitative analysis who has spent precious time in searching through reference volumes for information corroborative of his tests will be pleased to find a single handy book that answers this purpose. The tables compiled by the author give the chief properties of the more common inorganic substances, and include the metals of six groups with their oxides, hydroxides, etc., and also cover the acids, non-metals, and rare metals. The properties given include state, color, luster, crystalline form, deliquescence, efflorescence, stability in air, action on test paper, melting point, behavior when heated, solubility in water, alcohol and acids, and any other characteristic properties; the formulae, chemical names and common names are in each case given. In this second edition, atomic weights are revised to correspond with the Report of the International Committee for 1916.

THE MANUAL OF STATISTICS. Stock Exchange Handbook, 1916. New York: The Manual of Statistics Company. Svo.; 1,106 pp. Price, \$5.

All who are interested in finance, securities, and the Stock Exchange, from whatever angle, find in this Manual an indispensable desk book. All the essential facts and figures of railroad, industrial, and government securities are concisely given. In the case of corporations, their origin, the date of their formation, the nature of their property holdings, their authorized capital stock, the amount issued, and the par value, profits and dividends, and the officers and directors, may all be found. American and Canadian securities are quoted at high and low for the three years 1913-1915, and there is much tabulated information relating to mining stocks, cotton, and the produce markets. Other important statistics are those dealing with money markets and the banks and trust companies. The work offers a most complete and reliable presentation of financial, railroad, and industrial interests for the benefit of the investor, and is recognized as the leading compilation of its kind.

OZONE. Its Manufacture, Properties and Uses. By A. Vosmaer, Ph.D. New York: D. Van Nostrand Company, 1916. Svo.; 197 pp.; 75 illustrations. Price, \$2.50 net.

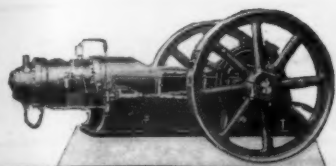
The author points out that the subject of ozone touches at various points chemistry, physics, bacteriology, hygiene, manufacturing processes, and electrical and mechanical engineering. His treatise gives the results of fifteen years' experience and research, and frequently expresses opinions at variance with accepted views. The constitution and properties of the substance are discussed in a most interesting introductory section; the second division of the volume deals with its manufacture, by both electrical and non-electrical methods; here the brush discharge is described at some length, and as this discloses phenomena and offers possibilities that have heretofore been somewhat neglected, both text and illustration will be followed attentively by the reader. The third section deals with the various uses of ozone, as a purifier, sterilizer, and medicament, and with its industrial applications. The work concludes with a list of American patents bearing on ozone, and a bibliography.

MAKING TYPE WORK. By Benjamin Sherbow. New York: The Century Co., 1916. 12 mo.; 129 pp. Price, \$1.25 net.

No advertising can be entirely successful that does not embody the essentials of good practice in the employment and arrangement of type. Mr. Sherbow's body of doctrine is thoroughly sound and wholesome, and never loses sight of the primary aim of the advertisement—to draw the eye to it, and the eye and the mind into it. He teaches us to avoid the faults that spoil what might otherwise be excellent material; to eliminate the confusion and strain caused by ill-assorted types, unevenness of color, close-lining, the over-use of capitals and italics, and the under-use of blank space. Widely-known advertisements are freely reproduced, and are skillfully dissected, criticized, and amended. Throughout the work is stressed the principle that the sense should determine the form, not the form the sense.

THE SWISS ARMY SYSTEM. By Captain Remy Faesch, 22nd Infantry Regiment of the Swiss Army. New York: G. E. Stechert & Co., 1916. 12 mo.; 24 pp.; illustrated. Price, 25 cents.

This concise explanation of the compulsory system of the Swiss Federal army is a timely response to the interest now being manifested in the system. The military duties of the citizen and of the community are briefly sketched, and the cost per capita is given; the school drill and the work of the Cadet Corps is mentioned, the mode in which officers are procured is indicated, and the peace duties of the citizen are defined.



Why Not In Your Power Plant?

Bessemer Engines are running in 16,000 power plants, saving and making money for their owners. In many instances these engines replaced motors and steam engines and in all instances have greatly reduced the cost of power.

Bessemer Oil Engines

(Awarded Gold Medal Panama-Pacific Exposition)

Furnish steady, dependable power by burning the fuel and crude oils, so abundant and cheap. Write us your power requirements and learn what a Bessemer installation will save for you.

Why Not In Your Power Plant?

Our complete line: Fuel Oil Engines from 15 to 185 H.P. Gas Engines, 5 to 350 H.P. Kerosene Engines, 2 to 8 H.P.

THE BESSEMER GAS ENGINE COMPANY
14 York Street Grove City, Pa.

Rothmotors Carry 25% Overload

In many installations, it is impossible to pre-judge the exact power required. In others there are times when an overload capacity is required for short periods. Rothmotors fit these conditions by reason of their overload capacity.

The unusual cool running performance of Rothmotors is due to low internal losses and design of the frame and bearing brackets which does not retard ventilation set up by armature.

There are Rothmotors for every purpose, each one capable of the same splendid service all Rothmotors have given for years.

Write today for facts about motor or any electrical machinery

Roth Bros.
& Co.

198 Loomis Street
Chicago, Ill.
Agencies in All
Principal Cities



Dry Goods

Founded by Max Jägerhuber
in 1899

Recognized by the foremost wholesale and retail merchants as the standard authority on textile fabrics, their fashions, colors and distribution. It projects and illuminates all important subjects pertaining to the trade, and contains more interesting and cleverly written sketches and articles than any other publication in this line. It is the medium through which the brainy men of the trade prefer to speak.

Subscription-price, \$3.00 a year. Foreign, \$4.50

DRY GOODS PUBLISHING CO.
116-120 WEST 32d STREET, NEW YORK

HANDY MAN'S WORKSHOP AND LABORATORY

Compiled and edited by A. Russell Bond.
6x8 1/2 inches. Cloth. 467 pages. 370 illustrations. \$2.00

A compilation of hundreds of valuable suggestions and ingenious ideas for the mechanic and those mechanically inclined. The suggestions are practical and the solutions to which they refer are of frequent occurrence. It may be regarded as the best collection of ideas of resourceful men published.

MUNN & CO., Inc., Publishers
Woolworth Building New York City



Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14143) E. P. du P. writes: I notice an inquiry as to boring holes in glass in your issue of June 24th, 1916, the inquiry number being 14111. Permit me to tell of a method I have used which is free from certain objections and limitations which govern that given by your paper. My method, which I got from some source now forgotten, permits of making any sized hole and of eliminating all danger of breaking when "coming through." Take a brass tube of the size of the desired hole and have the end turned true, smooth and square. Arrange it in wooden bearings in a vertical position so that the end rests upon the glass. Place on the tube a small wooden pulley, say 3 inches diameter for a 3/4-inch hole and drive it from some source of light continuous power such as a small water motor. A string belt if given considerable length, works well. The speed should be from 150 to 300 R. P. M. for the size given above. This is allowed to run, resting with its own weight (the size above being about 12 inches long of medium weight tubing) and the interior of the tube is kept filled with No. 100 emery or carborundum powder mixed with machine oil so that it will flow freely. This will gradually work out over the glass and maintain a cutting action. The drilling progresses very slowly, 24 hours being required to drill a 1/4-inch plate, but the resulting hole is smooth and round and entirely free from chipping on either side. The process requires attention only at long intervals as the emery and oil works out very slowly. Any sized hole can be drilled in this manner, but the hole will be found to be just a little "full" of the size of the tubing used. I think E. A. V. will find the method very satisfactory.

(14144) N. B. writes: In the July 1st issue of the SCIENTIFIC AMERICAN, C. E. asks in query No. 14128 for an explanation of the fact that differently colored letters projected upon a screen at the same time appear to lie in different planes. I believe that the following explanation accounts for the phenomenon. The difference of the focal planes for red and violet rays in the eye amounts to 0.5 mm. Consequently, if a red and violet letter are shown simultaneously on a screen, more effort is required on the part of the ciliary muscle of the eyeball to bring the red letter in focus upon the retina than is required to bring the violet letter in focus. Since we judge the distance of objects to a great extent by effort required to bring them in focus, it is evident that in the above illustration that the red letter will appear to be closer to the observer than the violet letter. Any two differently colored images projected simultaneously and situated closely together upon a screen will give this illusion. The degree of the illusion will depend upon the differences of the focal planes of the colors. A careful reading of the chapter on "The Dioptric Mechanisms of the Eyeball" in Starling's "Human Physiology," Ed. of 1912 will make the above explanation more clear. The first paragraph on page 58 deals with the answer to C. E.'s query.

(14145) A correspondent who resides 370 miles from New York City reports being awakened by the sound of the explosion in New York Harbor, on Sunday morning, July 30th, and that he felt his house shake with the shock. He states that a neighbor also felt the same shock, and was awakened by the noise. He inquires if others at a greater distance had a similar experience? A. This sound and shock and destruction, awful as it was, has been greatly surpassed by volcanic explosions, in recent years. In 1883 an eruption on the Island of Krakatoa, blew three islands to pieces, covering them with from 6 to 200 feet of scoria. Every living thing on the islands was killed, including thousands of human beings. The shock of this explosion was recorded on instruments entirely around the world. It culminated opposite Krakatoa in 18 hours, moving with a velocity of about 700 miles per hour, and then spread out and culminated several times afterward. The restoration of vegetable and animal life to these islands is described in the SCIENTIFIC AMERICAN, Vol. 115, No. 6.

(14146) E. J. A. asks: I read that water cannot be heated beyond the boiling point, but would simply pass into steam as the heat applied was increased. Is this so? A. Neither water, nor any other liquid, can be heated above its boiling point in the open air and remain a liquid. When water reaches its boiling point all the heat which goes into the water is spent in changing the water to steam, and no rise of temperature can take place. To heat water above its boiling point in the open air it must be inclosed in a



Once Too Often

Two pairs of Tire Chains were in the tool box, but he did not stop to put them on.

An evil impulse tempted him to continue over the wet pavements with bare tires. He ventured on for a few blocks, and then, in a flash, came the frightful skid leaving death in its wake.

How strange it is that some motorists are sometimes tempted to take a chance. They carry Tire Chains in their tool boxes, but they do not put them on at the first indication of slippery going. They wait too long once too often and disastrous skidding accidents result.

"Put on Tire Chains at the First Indication of Wet and Slippery Streets"

is a Safety First Commandment of vital importance. It should always be obeyed by all motorists for the protection of all road users.



—If You Have a Concrete Floor

You should know that thousands of floors have been hardened, dust-proofed and waterproofed by Lapidolith.

In every state, in the leading cities of Canada and in foreign countries, there are now thousands of Lapidolized floors.

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strong boiler, and then its temperature can be raised above 212 deg., since its boiling point is raised by placing the water under pressure. In a steam engine boiler the water may be much hotter than the boiling point in the open air. When the gauge pressure is $3\frac{1}{2}$ atmospheres the temperature of the water will be 300 deg. Under pressure water can be heated to a very high temperature, but in the open air it cannot be. By the term "boiling point" is meant the temperature at which a liquid boils in the open air or at normal pressure.

(14147) M. C. M. W. asks: Please give a full description of what is the cause of the waves in the Gorge of Niagara. Have the rocks at the bottom anything to do with the waves at the top, or is it because of the water being crowded into the narrow gorge? Would the effect of a rock on the bottom be lost on the surface because of the great depth of water? A. Tarr's College Physiography, page 153, has this statement: "Above the whirlpool are the most notable rapids in the river, the Whirlpool Rapids, the exact origin of which is not yet determined, though there is some reason for believing them to be due to the presence of large limestone boulders, which dropped into their present place from a waterfall which existed here before the last advance of the ice when the buried gorge was being formed." We send the book for \$3.75 postpaid. If the river had a smooth bottom it is certain that the water would rush swiftly down the gorge without tumbling in great stationary waves as it does at certain points. The rough bottom causes the disturbance on the surface.

(14148) G. A. S. asks: I would like to know if there are any metals, or other substances, which are either attracted or repelled by light, in which light acts in the same form as a magnet, and if there are, what books there are on the subject? I have read that moths gather around lights at night owing to some substance in their bodies being drawn or attracted by the light. A. We know of no metals or other substances which are attracted by light as iron is by a magnet. From the nature of light it does not seem possible that this should be the effect of light upon anything. The pressure of radiation from the sun, which becomes light when it enters an eye, is believed to be sufficient to push very light particles away from the sun. In this way the driving of the tails of comets back from the head of the comet is accounted for. Many animals seek a light in the night, in fact nearly all animals, birds and insects do so. It does not seem necessary to call in any mysterious force to account for this.

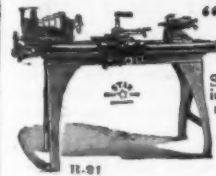
(14149) E. J. H. asks: Kindly give me a simple formula for making good soap bubbles. A. For a soap solution which will furnish a strong and durable film use palm oil soap, 1 part; glycerine, 8 parts; water, 8 parts. Or dry castile soap, 1 part; glycerine, 15 parts; water 20 parts. The soap is put into a quart jar or bottle with the water and shaken repeatedly till the soap is dissolved. If the solution when it settles is not clear, pour it off and add another portion of water. Repeat the shaking. The second solution will probably be all right. Then add the glycerine and shake well together. These formulae are from our *Cyclopedia of Receipts*, price \$5.00. The book by C. V. Boys, "Soap Bubbles," which we send for \$1.20, treats the subject of making and experimenting with soap bubbles very fully. It is fully illustrated.

(14150) C. A. L. asks: Please tell me, what amount of heat and light is given off by Jupiter? A. The planet Jupiter reflects 62 per cent of the light of the sun which falls upon it. This is a very large per cent since white paper reflects 78 per cent of the light which falls upon it. Some have thought that Jupiter is self-luminous but, according to Young there is no proof, and little probability, that this is the case. According to the best measurements Jupiter sends us as much heat as 4.7 standard candles would send at a distance of 8.7 miles. You will find these data in "Young's Manual of Astronomy," pages 384 and 514. We send the book for \$2.50 postpaid.

(14151) A. T. H. asks: Will you kindly advise me in the enclosed stamped envelope why a barber lathers the face; in other words, is the lather put on the face to soften the beard or to stiffen it? This point I am very anxious to know to settle numerous arguments, as I have contended the lather is put on the face to stiffen the beard and not to soften it, as most people, including experienced barbers, contend. A. Soap, in the form of a semi-liquid foam, performs two offices in shaving. As a very strong alkali it acts upon the hair to soften it. This effect is heightened by the rubbing which the barber gives to bring the soap into all the spaces around the hair of the beard. The other office of the lather is to hold the hair from yielding when the razor cuts it off. We suppose this holding of the beard from bending before the razor blade is what you mean by "stiffen." The lather does not stiffen the beard in the sense of making it harder to bend, for the softening of the hair by the alkaline action of the soap is unavoidable. A sufficiently strong alkali, such as concentrated potassic hydrate, would actually dissolve the skin and hair after a time. Probably the more important action of the lather is to soften the beard so that the razor will not be dulled so rapidly in cutting it.

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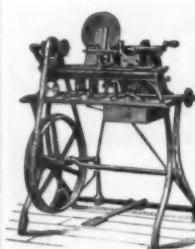


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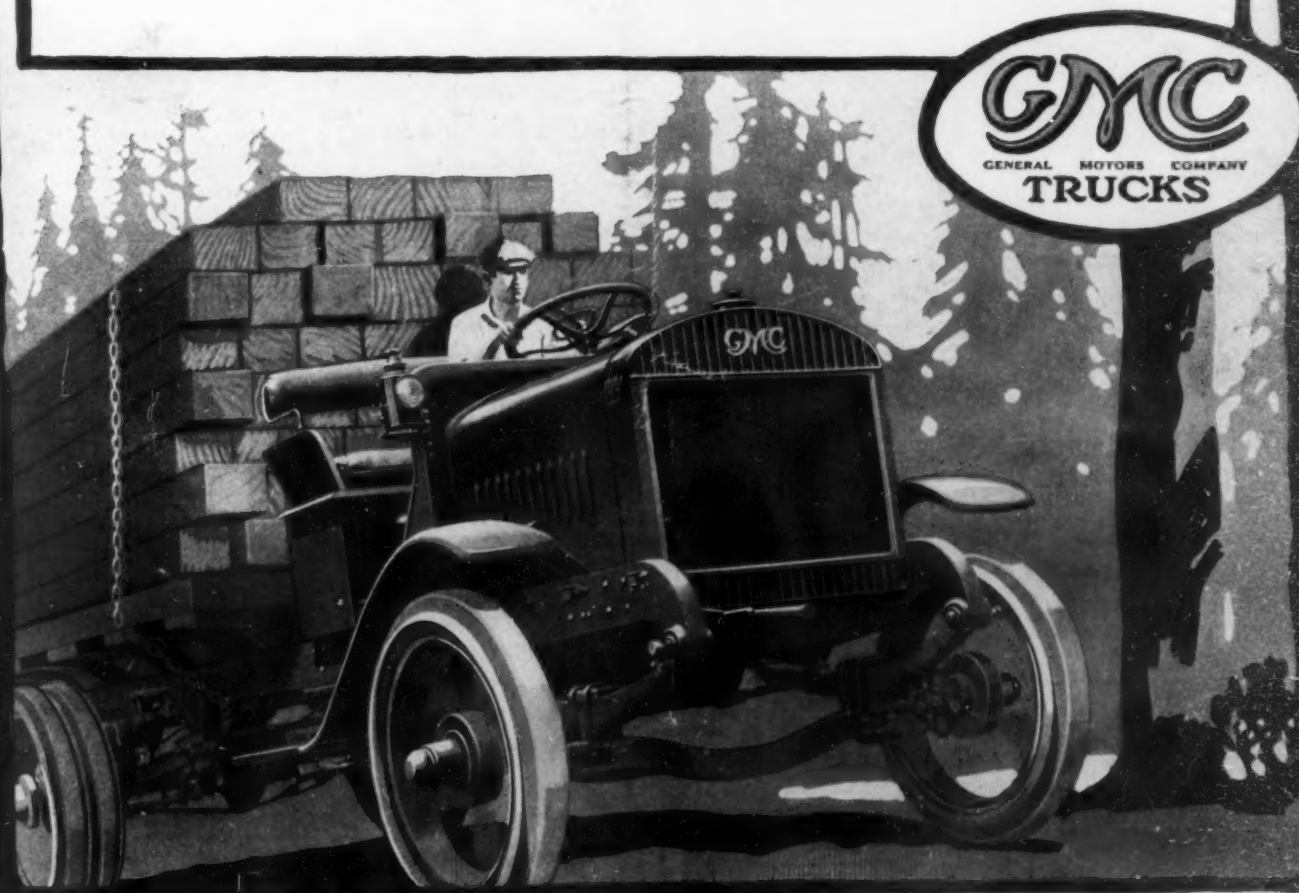
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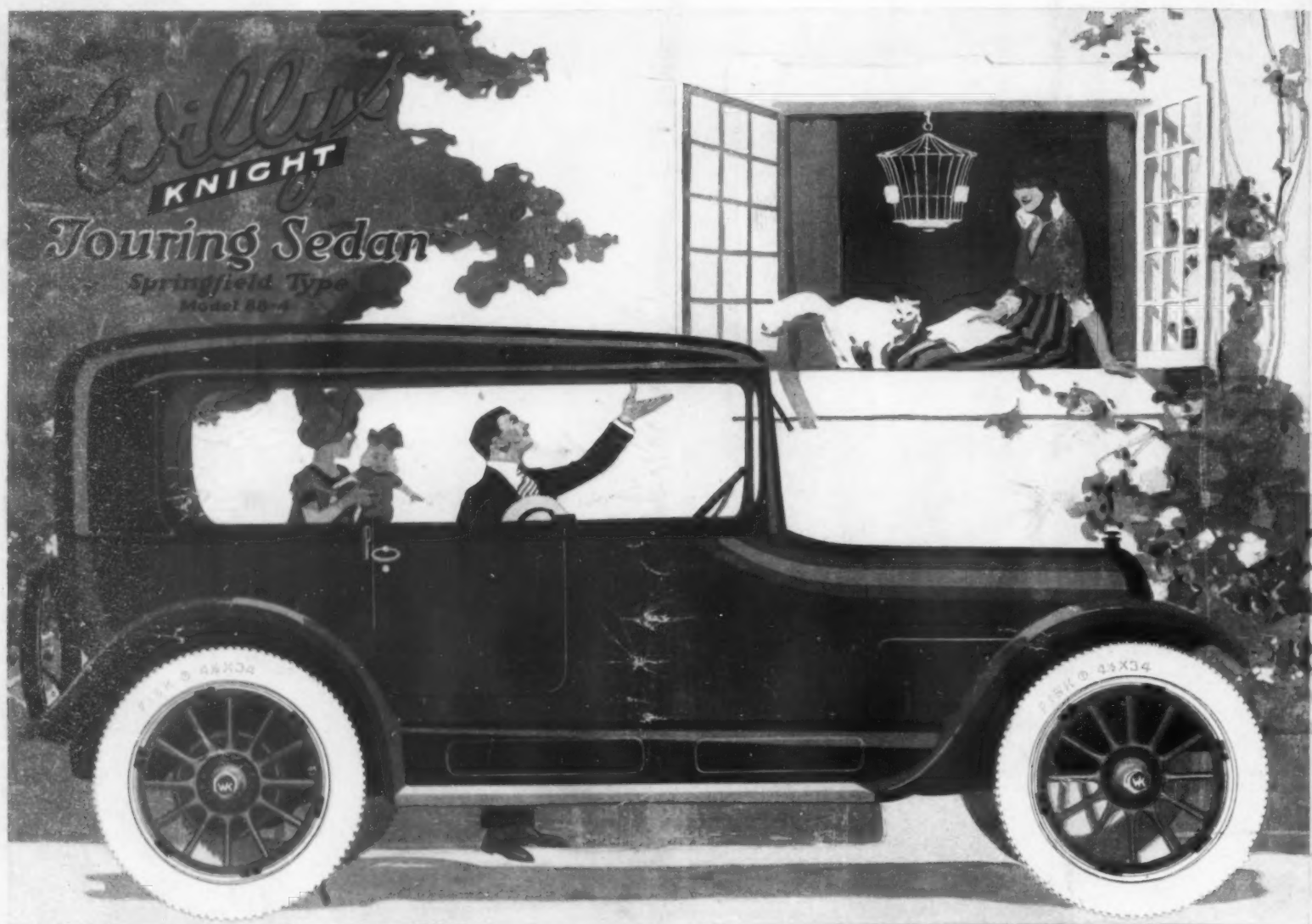
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